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THESIS – THÈSE

Title of Thesis – Titre de la thèse

Diagnostic Reasoning in Clinical Nursing: An Analysis of Cognitive Strategies – A Replication and Extension

Degree for which thesis was presented
Grade pour lequel cette thèse fut présentée

Masters of Nursing

Year this degree conferred
Année d'obtention de ce grade

1985

University – Université

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DIAGNOSTIC REASONING IN CLINICAL NURSING: AN ANALYSIS OF COGNITIVE STRATEGIES - A REPLICATION AND EXTENSION

BY

EILEEN BOURRET THAUBERGER

(C)

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF NURSING

FACULTY OF NURSING

Edmonton, Alberta

Spring, 1985

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Diagnostic Reasoning in Clinical Nursing: An Analysis of Cognitive Strategies - A Replication and Extension submitted by Eileen Bourret Thauberger in partial fulfilment of the requirements for the degree of Master of Nursing.

Supervisor

DATE: April 19, 1985

To my parents, Fernand and Kathleen Bourret, who have always supported me in all my endeavors.

ABSTRACT

This study was designed to examine the thinking processes, within information processing theory, used by registered nurses when identifying patient problems in clinical practice and to determine the extent to which that thinking reflected one aspect of the model of diagnostic reasoning: the activation of diagnostic hypotheses and other inferences derived from clinical data. Videotaped patient simulations and simulated nursing reports served as stimulus materials to elicit the diagnostic reasoning processes of the subjects. A written examination tested knowledge of the content related to the videotaped simulation. Reliability and validity of the instruments were established.

Ten baccalaureate prepared medical-surgical nurses were the subjects of this study. Verbalizations of the subjects, as they identified the simulated patient's problems, were tape recorded and transcribed. The numbers and kinds of inferences made and number of cues used to make those inferences were identified. Seven different categories of inferences were examined. In addition, timing of inference activation and computation of written examination scores was done.

The inferences most frequently activated were those which explained cues other than those of immediate concern. No subject activated all three accurate hypotheses presented in the simulation. Further, the more shifts in thinking a subject made during the diagnostic workup, the less likely she was to activate accurate and plausible hypotheses. Subjects tended to use all cues available from the nursing report for

inference activation, while they used approximately one-half of the cues available from the videotaped simulation. In addition, subjects tended to activate inferences very soon after seeing the videotaped simulation. Less experienced subjects tended to score higher than more experienced subjects on the written examination. Subjects who scored higher on the written examination tended to activate more accurate and plausible hypotheses.

It was concluded that activation of hypotheses was a component of the diagnostic reasoning process used by the nurses in the sample. Further, those diagnostic hypotheses were activated by subjects very early in the diagnostic workup. A discussion of the results and their significance for nursing was presented. Study limitations and suggestions for further study were also identified.

ACKNOWLEDGMENTS

This study could not have been completed without the support and efforts of many people. It is to those people I would like to express my gratitude.

I am grateful to the members of my thesis committee - Dr. Phyllis Giovannetti (chairperson), Dr. Peggy-Anne Field and Dr. Alinda Friedman - who guided me, with knowledge, expertise and much support, along the sometimes arduous research path.

Deep gratitude to Dr. Christine Tanner, who not only provided me with the research instruments to enable me to undertake this study, but who was always available for long-distance consultation and support. Also thanks to Dr. Tanner's diagnostic reasoning research team - Dee J. Putzier, Una Beth Westfall and Karen Padrick, who shared their ideas with me and helped with data coding.

I am indebted to the nurses who participated in this study. They willingly gave of their free time to assist me. Their interest and commitment to improved nursing practice through nursing research is most encouraging.

ACKNOWLEDGMENTS (Cont'd)

Many thanks to my family, friends and colleagues, who assured me I would finish this project, especially on those days when I thought it was a hopeless task. I am particularly grateful to José who patiently assisted me with data coding and with whom I had many stimulating discussions about this project.

A final thank you to the Canadian Nurses' Foundation and the Alberta Foundation for Nursing Research, whose support of this research project was most appreciated.

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CHAPTER ONE

INTRODUCTION

A. Purpose of Study

Widespread agreement exists in nursing literature that the practice of nursing includes a problem-solving component (McCarthy, 1981; Yura and Walsh, 1978; Bailey and Claus, 1975; Goodwin and Prescott, 1975; Mayers, 1972). This problem-solving component is expressed as the nursing process, a series of activities by which patient problems amenable to nursing intervention are identified, appropriate nursing intervention is delivered and the effect of the intervention is evaluated (Aspinall and Tanner, 1981). The problem identification step (also called the assessment phase) of the nursing process is regarded by many as the most critical component of the entire nursing process (Putzier and Padrick, 1984; Aspinall and Tanner, 1981; Mundinger and Jauron, 1975; Kelly, 1966; and Hammond, 1966) for it is this phase which provides the framework by which nursing care is delivered. If errors are made in determining the patient state which requires nursing intervention, potentially deleterious effects can accrue to the patient.

The importance of the diagnostic or problem identification phase of the nursing process is further illustrated in that nursing practice standards in many jurisdictions (see for example the A.A.R.N. nursing practice standards) include a diagnostic standard. This implies that nurses have the ability to diagnose or identify the patient state amenable to nursing intervention, an assumption which has not been fully explored and tested through nursing research (Kim, 1980; Koehne-Kaplan and Tilden, 1976; McIntyre, McDonald, Bailey and Claus, 1972).

There has been little emphasis in nursing research on how nurses proceed from the data collection phase of the nursing process to the planning phase. Those few studies which have examined aspects of diagnostic reasoning in nursing lend support to the notion that more comprehensive research studies of diagnostic reasoning need to be conducted. For instance, Baumann and Bourbonnais (1982) reported that 10-45% of their nurse subjects were unable to provide a rationale for the rapid decisions they made with respect to a patient with cardiac problems, although it has been known that strategic behavior may not be open to the introspective process (A. Friedman, personal communication, April 9, 1984). Aspinall (1976) noted that 21% of her nurse subjects (Total N=187) failed to identify respiratory problems in the written case studies which formed the response stimulus for her study. In two studies of nursing diagnosis from the perspective of concept attainment and critical thinking, nurse subjects were required to identify all possible nursing diagnoses from two written case studies (Matthews and Gaul, 1979). The authors reported that the nurses' diagnostic ability (as measured by the number of correct diagnoses the nurses made) decreased as the number of patient diagnoses increased. These data clearly suggest that nurses appear to have difficulty identifying clinical inferences from written case studies. Since this has implications for clinical practice, the need exists to further explore the diagnostic reasoning strategies utilized by nurses in making clinical inferences about the state of the patient.

In addition, those few investigators who have studied or described diagnostic reasoning in nursing have often assumed that the medical

diagnostic reasoning model, most often the model described by Elstein, Shulman and Sprafka (1978), can be applied to nursing (Carnevali, 1983, 1984; McCarthy, 1981; Moritz, 1980; Henderson, 1978; Aspinall, Jambruno and Phoenix, 1977.) This assumption is only now being examined more thoroughly in nursing research conducted by Tanner and associates (in progress) at the Oregon Health Sciences University, Portland, Oregon.

This present study is, in part, a replication of the research in progress at Oregon Health Sciences University, School of Nursing. The overall purpose of the present study was to examine the thinking processes used by registered nurses when identifying patient problems in clinical practice and to determine the extent to which this thinking reflects one aspect of the model of diagnostic reasoning: the activation of diagnostic hypotheses and other inferences derived from clinical data (Westfall, Tanner, Putzier and Padrick, manuscript submitted for publication, 1985).

B. Significance for Nursing

The inferential or diagnostic task is central to all nursing practice (Kelly, 1966). "The success of the professional nurse's daily work depends to a large extent on her ability to think constructively and to arrive at reasonable alternatives quickly." (Sculco, 1978, 40). To date little is known about the diagnostic reasoning activities nurses utilize in their interactions with patients. This has implications for both nursing practice and nursing education.

Hammond (1964, 317) noted the "most important function [of the nurse] is appraisal of the state of the patient, and the ability to take appropriate action". With respect to clinical practice the skill with which practitioners apply diagnostic reasoning in providing patient care is related to the quality of the care delivered (Matthews and Gaul, 1979). That supposition is based on the assumption that quality nursing care can be delivered only if the appropriate patient state amenable to nursing intervention is identified. If, for example, important data are overlooked or too much significance is attached to other data, the patient state may be incorrectly identified. On the basis of clinical judgments, recommendations for nursing action are made, which if carried out, may make the difference between comfort and pain, illness and health, and so on (Sarbin, Taft and Bailey, 1960). In addition, nurses are expected to make accurate inferences about the state of the patient given uncertain, observable or subjective data (Hammond, 1964; Westfall et al., 1985). Identifying the kinds of inferences nurses make about patient states and delineating the principles and strategies used in diagnostic tasks should improve the process of developing clinical reasoning in nurses (Kassirer and Gorry, 1978).

Tanner (1983) notes that educational methodologists have argued that the development of teaching strategies "to teach any task rests on an analysis of how competent individuals perform that task" (Tanner, 1983, 2). Consequently, an understanding of the cognitive strategies employed by expert nurse clinicians when making clinical judgments should lead to the development of more precise and efficient instructional strategies to teach these processes to nursing students (Tanner, 1983; Schwartz and Simon, 1976). Knowledge about cognitive strategies in nursing should also assist nurse educators provide nursing students with information seeking strategies to be used when interacting with patients. Furthermore, an analysis of the types of cues used in making clinical judgments and the role of perceptual biases and preconceptions in making clinical judgments, should assist nurse educators in teaching clinical problem-solving in nursing.

CHAPTER TWO

CONCEPTUAL FRAMEWORK

A. Introduction

There are many terms, descriptions and research methods in medical and nursing research to describe and examine the cognitive activities of clinicians in identifying and managing patient problems (e.g. clinical judgment, problem solving, decision making, inferential reasoning, diagnostic reasoning). For the purpose of this study, diagnostic or clinical reasoning was the term used to describe the cognitive activities nurses utilize in identifying patient problems during nurse-patient interactions.

B. Information Processing Theory

Following an extensive review of related medical literature, Elstein, Shulman, and Sprafka (1978) concluded that a unified theory of problem solving and clinical judgment (diagnostic reasoning) had not yet been formulated. In general, three basic research paradigms have been employed to examine clinical diagnostic reasoning: an information-processing or process tracing approach which views human cognition as a "cognitive process that can be seen as a sequence of internal states successively transformed by a series of information processes" (Ericsson and Simon, 1980, 223); a "probablistic or Bayesian approach that views clinical inference as one form of decision making under uncertainty (e.g.Tversky and Kahneman, 1974); and a regression or lens model approach (e.g. Hammond et al., 1966, 1967) that investigates capturing judgmental policy and the modelling of judgments by means of regression

equations" (Elstein, 1979, 17). The information processing model of cognition formed the conceptual framework of this study as that model seeks to describe and to explicate the cognitive activities of clinicians as they attempt to solve clinical problems.

The information processing approach to clinical judgment employed for this study is derived from the extensive theoretical work on thinking conducted by Newell and Simon (1972). Their original work was based on an analysis of the performance of intelligent adults on short, moderately difficult tasks of a symbolic nature, e.g. chess, symbolic logic. Although derived from problem solving in relation to perceptual motor skills, the Newell and Simon approach to problem solving has been utilized by Elstein and associates (1978) in their study of medical diagnostic reasoning. As Chase and Chi (1980) noted there may not be any theoretical justification for differentiating between perceptual-motor and cognitive skills with respect to strategies used to solve particular problems.

A problem, according to Newell and Simon, exists when an individual wants something and does not immediately know what actions to take to obtain the desired product. The individual is viewed as an information processing system when solving problems, with interaction occurring between the task environment (the problem) and the problem space (the internal representation of the problem; the "space" where problem solving occurs). See Figure I. When an individual is presented with a problem,

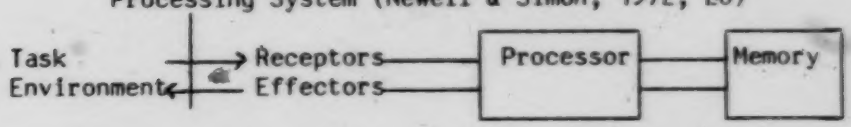
> ....he must encode these problem components--defining goals, rules, and other aspects of the situation--in some kind of space that represents the initial situation to him, the desired goal

> situation, various intermediate states, imagined or experienced, as well as any concepts he uses to describe these situations to himself. (Newell and Simon, 1972, 59).

The problem space and the problem formulation impose organization on the problem solving process (Newell and Simon, 1972).

Figure 1.

General Structure of the Information Processing System (Newell & Simon, 1972, 20)



The problem representation, which is the internal cognitive structure corresponding to the problem, is developed by the problem solver based on his/her domain-related knowledge and organization of this knowledge (Chi, Feltovich and Glaser, 1981, 122). A representation can correspond closely with the problem stated (e.g. the "givens", desired goals and legal problem solving operators in the Newell and Simon model; Chi et al., 1981), and/or can contain embellishments, inferences and abstractions which may help to enrich the representation (Chi et al., 1981).

Ease of problem solving is related to the quality of the problem representation by the problem solver (Chi et al., 1981).

> Human problem-solving is to be understood by means of describing the task environment in which it takes place, the space the problem solver uses to represent the environment, the task itself, the knowledge about it that is gradually accumulated, and the program the problem solver assembles for approaching the task. The problem solver's program extracts some of the structural information that is embedded in the task environment in order to find solutions by means of a highly selective search through the problem space. The problem space (where problem-solving takes place) contains not

> only the actual solution but also possible solutions that the problem solver might consider. (Yura and Walsh, 1978, 56; adapted from Newell and Simon, 1972.)

The task environment refers to the external environment as well as goals, problem or task (Newell and Simon, 1972). The task affects the way in which the environment is viewed by the problem solver. That is, a problem solver responds to information in the external environment that she/he perceives to be relevant to the problem at hand. "The only aspects of the task environment that are relevant to solving a problem in a particular problem space are those reflected in the structure of that space...and the effectiveness of a problem solving scheme depends completely on its reflecting aspects of the structure of the task environment" (Yura and Walsh, 1978, 58; adapted from Newell and Simon, 1972).

A further interpretation of information processing theory is that it is based on the concept of bounded rationality (Elstein, 1979). That is, limits exist to the human capacity for rational thought (and consequently for an individual's ability to verbalize his/her thoughts which has implications for the introspective techniques used in this study. This will be discussed in greater detail in the methodology section). The working memory of a human being is relatively small in comparison to long term memory (LTM), which is perceived as being limitless in capacity. This necessitates that data be processed serially by the problem solver or that not all the data that are collected be used in problem solving (Elstein, 1976). It has been suggested that expert problem solvers cope with this limitation by storing a large repertoire of patterns (related to domain knowledge) in

LTM, which are quickly recognized and used during problem solving (Chase and Chi, 1981). Thus, an expert nursing diagnostician would be able to perceive relevant patient cues as patterns that trigger appropriate retrieval mechanisms in the LTM to be ruled in or ruled out as diagnostic hypotheses.

The amount of information one can attend to at one time is determined by the capacity of the short term memory. This capacity has been determined to be 7 ± 2 units (Miller, 1956). This capacity can be maximized if data are "chunked" together or if heuristic techniques are used. For instance, Elstein and associates (1978) in their study of medical problem solving found physicians could entertain more than the usual five diagnostic hypotheses if they "nested" the hypotheses together. Four or five possibilities of infectious diseases could be considered under the general hypothesis of "infection" and data collection could proceed from that point.

Another limit to the ability to problem solve is the "content" of one's LTM (Elstein, 1979). If one cannot access the information contained in the LTM or if the information is not there, obviously ability to reason or solve problems will be restricted. In clinical nursing one would expect, therefore, that an expert practitioner (one who presumably has accumulated more information in LTM) will be able to solve problems more efficiently than a novice practitioner or a student. Elstein and associates (1978) found this to be the case in their study of diagnostic reasoning abilities of criterial and

non-criterial physicians.[1] Interestingly, two nursing investigators reported the opposite finding (Aspinall, 1976; Davis, 1972) in that ability to identify patient problems from a case study and film decreased with the amount of clinical experience of the subjects. A possible explanation for the discrepancy between Davis' and Aspinall's results and Elstein's results is that in the former studies, the nurse subjects, particularly those with more experience, may not have been as familiar with the process of identifying patient problems (diagnostic hypotheses) as this is an activity that has only relatively recently received prominence in nursing (Carnevali, 1983).

To summarize the information processing approach to problem solving as described above,

> ...the problem space and the problem formation impose an overall organization on the problem solving process utilized by the problem solver. The process is initiated with the translation of input by the problem solver. This produces for the problem solver an internal representation of the external environment, and at the same time, a selection of a problem space. The problem solver then proceeds within the framework of the internal representation thus produced--a representation that may render problem solutions obvious, obscure, or perhaps unattainable. For example, the problem solver may simply recognize the answer to the problem....Recognition processes are important for solving problems not only because they can be used in the solution of difficult problems, but also because problem-solving often proceeds by reduction. (Yura and Walsh, 1978, 59; adapted from Newell and Simon, 1972).

---

[1] A criterial physician was one judged by at least 5 of his/her peers to be the best diagnostician known to the respondent. A non-criterial physician was one who received one or no votes by his peers.

C. Clinical Judgment Research

Diagnostic reasoning research that proceeds from an information processing theory perspective "seeks to describe how clinicians adapt to the demands of a complex task environment" (Tanner, 1983, 13). This is accomplished primarily through analyses of cognitive strategies that clinicians employ as they solve clinical problems.

The most extensive series of studies of diagnostic or clinical reasoning using an information processing approach was conducted by Elstein and associates (1978) on medical problem solving. From their study of physicians, a model of clinical or diagnostic reasoning emerged. The Elstein model suggests that clinical problems are solved by an:

"iterative process of:

1. Data collection (cue acquisition): the process of gathering or collecting data.

2. Hypothesis generation: the process of generating alternative formulations of the problem.

3. Cue interpretation: the process of interpreting the evidence collected in light of these hypotheses.

4. Hypothesis evaluation or judgment: the process of combining information to reach a diagnostic decision." (Elstein, 1979, 20).

Recently, Carnevali (1983) adapted the Elstein model to describe the diagnostic (problem identification) process used by nurses, which she purports is "identical for all disciplines" (p.58).

Additional characteristics of medical clinical reasoning include the following (Elstein, 1979): Medical problems are typically resolved by

the physician selectively collecting data and combining them into a decision or judgment. Unlike the usual experimental problem solving situations, all the data are not available to the physician at the time of the initial problem formulation.

Moreover, medical problem solving tends to proceed in a hypothetico-deductive fashion; that is, the physician entertains a hypothesis and then collects information to support or refute the hypothesis (Elstein et al., 1978). As Tanner (1983) observes this approach is contrary to the usual medical/nursing instruction whereby students are instructed to collect all the data available before identifying patient problems.

A number of other variables impinge on the clinical or diagnostic reasoning process (Tanner, 1983). These include:

1. Task variables: those elements which contribute to the overall complexity of the problem situation e.g. the amount of information available to the clinician, number of patient problems, course of action available.

2. Contextual variables: These include "the circumstances and setting in which the clinical judgment is made; these are factors which may not be immediately apparent in the presenting situation but may nevertheless influence both the judgment process and its outcome. This category includes variables such as institutional policy, characteristics of the patient's physician, and time available to make the judgment." (Tanner, 1983, 3).

3. Clinician variables: Characteristics the clinician brings to the problem situation e.g. knowledge, clinical experience, inferential reasoning ability.

4. Risk/benefit variables: Those variables associated with the decision itself.

In the present study emphasis was placed on describing selected task variables and clinician variables and how they contribute to the diagnostic reasoning processes of clinical nurses.

CHAPTER THREE

LITERATURE REVIEW

A. Introduction

A literature review of the following topics was conducted: 1) nursing process and diagnostic reasoning; 2) clinical judgment research in nursing; 3) clinical judgment research in medicine, and 4) selected problem solving research.

B. The Nursing Process

Since Florence Nightingale's time nurses have been exhorted to be systematic and thorough in their observations of patient behavior. This systematic observation came to be embodied in the nursing process, a model which includes "an orderly systematic manner of determining the client's problems, making plans to solve them, initiating the plan or assigning others to implement it, and evaluating the extent to which the plan was effective in resolving the problems identified" (Yura and Walsh, 1978, 20). Although the nursing process model has been characterized as a three step (Carlson, 1972) or five step (Griffith and Christensen, 1982; Mundinger and Jauron, 1974) model, it is most often described as a four step model (Aspinall and Tanner, 1981; McCarthy, 1981; Yura and Walsh; and Bower, 1972). The four steps are the assessment phase, the planning phase, the implementation phase and the evaluation phase.

The assessment phase consists of the collection of data about the patient, which are then classified and analyzed to determine the patient problems (Bower, 1972). The planning phase follows, whereby appropriate

strategies are developed to solve the identified problems, with the implementation phase consisting of putting the plan into action. During the evaluation phase the effectiveness of the particular plan, in terms of problem resolution, is carried out (Bower, 1972). This process, in nursing practice, is evidenced by development of the nursing care plan (McCarthy, 1981).

The nursing process model has been viewed as a linear sequence model of thought processes as it relates to clinical judgment in nursing (Tanner, 1983). There is often little agreement as to what the term assessment means--is it data collection only, data collection and analysis or a clinical judgment (Mitchell and Walter in Walter, Pardee, and Molbo, 1976)? Furthermore, the linear nature of the nursing process model does not emphasize the assessment-diagnostic process whereby data observed by the nurse trigger retrieval of relevant diagnostic concepts or knowledge which in turn directs further data collection (Carnevali in Walter, Pardee and Molbo, 1976). Moreover, there is increasing commentary that the nursing process may not be the best model to represent the complex tasks of nursing. (See for example, Tanner, Benner and Grier, Clinical knowledge: controversies and countercurrents. Conference on research in nursing education, San Francisco, January, 1984.)

Other critics of the nursing process express concern that the emphasis in nursing on problem-solving depreciates the importance of the intuitive aspects of nursing--the so-called "art of nursing" (Henderson, 1982). Further, it has been suggested that nursing's enthusiasm to adopt the more generic problem solving process and call it the nursing

process is done primarily to legitimize the profession of nursing--to give it credibility as a profession which utilizes a problem solving or scientific framework in provision of care (Henderson, 1982; Geach, 1979). As noted by Soares (1978, 269) it behooves a profession "to establish a formalized systematic approach to the problem solving within its practice." There is concern, nonetheless, that undue emphasis on identification of problems ignores identification of the patient strengths (Personal communication: Faculty of Nursing, University of Alberta thesis seminar, December 5, 1983). It does not follow, however, that consideration of the cognitive skills involved in nursing implies that the art of nursing is not a significant component of nursing practice. Moreover, the implication that the "art of nursing" somehow involves an unscientific approach to care has not been demonstrated. As Elliott Sober aptly notes:

> The idea that clinical judgment involves some kind of nonlogical intuitive insight...has no more evidence on its side than the fact that we are now very much in the dark about how human beings solve problems. But ignorance of the logic of clinical discovery is no reason to think there is no such logic. With respect to the other alleged dichotomies...the uniqueness of the individual, the role of emotions, and the use of qualitative concepts [can be understood], in such a way that clinical judgment can be seen as a scientific undertaking (in Englehardt et al., 1979, xvii).

An additional difficulty in applying the nursing process in clinical practice is the confusion with terminology. The question of whether a nurse, in his/her interactions with a patient, is identifying a patient need, a patient problem, a nursing problem or a nursing diagnosis is often unclear. This semantic confusion is very much evidenced in the nursing literature.

For instance, the early nursing literature equated patient need with nursing problem (Chambers, 1962). Schaeffer (1974) and Carlson (1972) equate nursing diagnosis with patient need, while Gordon (1982) states nursing diagnosis is not synonymous with therapeutic need. Grier (1976) notes nursing decisions involve making inferences about a patient's needs while Mundinger and Jauron (1975), Price (1980), Gordon (1982) and Bloch (1975) differentiate between a need and a problem. This confusion no doubt led Bloch, in 1975, to encourage nurses to be precise with their language. According to Bloch a "problem" or "diagnosis" is viewed as a deficit in the patient's health state, while a "need" is the action necessary to meet that deficit; that is, a problem is solved by meeting a need.

Although Bloch (1975) views "diagnosis" and "problem" synonymously, Soares (1978) and Putzier and Padrick (1984) suggest that diagnoses are more complex entitities than problem statements because diagnoses incorporate etiological statements with the identified problems. The above confusion in terminology has probably contributed in large part to the difficulty nurses have in identifying what it is they do that is distinct from other helping professions. It is further proposed that emphasis in nursing research on how nurses think when gathering data and using nursing knowledge to identify patient health states may be more fruitful than labelling nursing diagnoses [which includes the identification of "critical defining characteristics" (Gordon, 1982, 9)] since the theory base of nursing is so limited at this time.

Although there is agreement among many nurse theorists that utilization of the nursing process model by clinicians involves a

cognitive activity, the nursing process model, according to McCarthy (1981), does not specify how the information that the nurse collects is processed and utilized. She cites this as an advantage of the nursing process model in that multiple approaches to information processing can be used. Unfortunately McCathy does not specify how the nursing process model does that. McCarthy goes on to equate the nursing process model with the clinical problem solving model in medicine as developed by Elstein and associates (1978). In contradistinction, Carnevali (1984) notes the diagnostic reasoning process is different than "the standard problem solving process" (or nursing process) in that the diagnostic reasoning model integrates (as opposed to apparent separation in the problem solving process) initial data gathering with subsequent diagnostic hypothesis generation. This initial generation of diagnostic hypotheses directs the subsequent data gathering to confirm or refute identified diagnostic hypotheses.

Thus there seems to be some confusion in the nursing literature as to whether the nursing process model (assessment-planning-implementation-evaluation) is similar to the diagnostic reasoning model (data gathering-hypothesis generation-further data gathering-diagnostic hypotheses) or whether they are two distinct models. Carnevali (1983) deliberately avoids using the term "nursing process" in her recent work, noting "as more nurses join the mainstream of multidisciplinary diagnosticians, it seems wise to use the share terminology of 'diagnosis and treatment' or 'management' that clinicians in other disciplines immediately understand rather than nursing jargon that is then sometimes deprecated, sometimes ignored" (Carnevali, 1983, xi).

Further evidence of the confusion between the two models is suggested by McCarthy's (1981) comparison of the nursing process model and the diagnostic reasoning model of Elstein (1978). McCarthy (1981) advances the case that the medical diagnostic reasoning model and the nursing process model are very similar. She suggests however, that the nursing process model is somewhat superior to the clinical problem solving model of Elstein in that the nursing process model allows for an expanded number of hypotheses to be entertained at one time (more than the 4-7 hypotheses Elstein and associates, 1978, suggest can be held at one time by the clinical problem solver) because the problems are easily documented in the nursing care plan. Having documented the hypotheses does not compensate for the fact that the clinician is able to entertain only a limited number of diagnostic hypotheses in his/her interaction with the client. There is nothing to suggest in the Elstein diagnostic reasoning model that the clinician could not develop a written plan of action that could be amended. Thus the supposed advantage of the nursing process model over the diagnostic reasoning model seems to be lost.

McCarthy's (1981) conclusion that the "nursing process seems to 'fit' extremely well with the bulk of the current ideas about clinical problem solving" (1981, 176) seems unwarranted given the state of present knowledge about the clinical problem solving model or diagnostic reasoning model in nursing. In fact nursing experts in the area of clinical knowledge (e.g. Tanner, Grier and Benner, 1984; Carnevali, 1984) suggest that the linear nursing process model is not the best model by which the practice of nursing can be described. It is the

purpose of this study to ascertain whether nurses do utilize a diagnostic reasoning model in their clinical practice and to identify, in part, the manner by which nurses process information to form clinical judgments.

C. Clinical Judgment Research-Nursing

1. Clinical Judgment Research - the Product

Interest in clinical judgment in nursing has centered on two topics--the product (i.e. diagnostic nomenclature) and the process of clinical judgment (Kim, 1980). Research on the former topic has focused on the identification of nursing diagnoses, including etiology and defining signs and symptoms (Gordon, 1976; Brown, 1974; Gebbie and Lavin, 1974). Identifying nursing diagnoses has proved to be a very difficult task. For instance, Nicoletti, Reitz and Gordon (1980) in an analysis of 722 observations of the diagnosis "alteration in parenting" were unable to elicit any specific critical defining characteristics. (A critical defining characteristic was given as a sign or symptom present in 100% of the cases in which the diagnosis was used.) It should be noted that Nicoletti and associates were able to identify clusters of signs/symptoms which may contain the critical defining characteristics but their analysis did not point to the critical defining characteristics.

Other criticisms of the movement to identify nursing diagnoses have centered on the apparent similarity of some nursing diagnoses with medical diagnoses (Lunney, 1982). Still others counter this criticism by noting there may be similarities between nursing and medical diagnoses but the mode of intervention by each profession is different

(Rossi and Haines, 1979; Fortin and Rabinow, 1979). For instance, both nurses and physicians may identify alteration in cardiac output in a patient, with physicians instituting medical treatment (e.g. medications) and the nurse instituting nursing treatments (e.g. bedrest).

It seems, however, that clinical nurses often have difficulty distinguishing between medical and nursing diagnoses as evidenced by the research of Sweeney and Gordon (1983). Their study of the use of nursing diagnoses by clinical nurses with 163 obstetrics/gynecology patients demonstrated that nurses had a tendency to label medical symptoms or problems as nursing diagnoses.

A criticism of the "group empiricism"[2] used by the National Group for the Classification of Nursing Diagnoses to identify nursing diagnoses is that 1) this approach may limit the number of diagnoses generated because only those in which all members agree constitute an approved diagnosis, and 2) there may be selection bias in the identification of nursing diagnoses because only those diagnoses with which the National group is familiar (or can recall) have a chance to be adopted (Tanner and Hughes, 1984). Moreover, the emphasis on nursing diagnosis as a product is often reduced to such discussion (although this is becoming less frequent) as should nurses diagnose (Gordon, 1982; Bruce and Snyder, 1982; Cushing, 1982; Clark, 1978; Bloch, 1975). Valuable time is spent defending this position to the extent that the

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[2] A method of determining "approved" nursing diagnoses whereby all members attending a National Conference for Nursing Diagnoses must agree on the diagnostic label, its etiology and defining characteristics (Tanner and Hughes, 1984).

reason this task is important (i.e. to identify the domain of nursing) is often lost.

"Only minimal information has been given to describing how nurses utilize information in the diagnostic process" (Gordon, 1980a, 39). Given the difficulties described above with identifying and elaborating the diagnostic labels in nursing, the process of diagnostic reasoning became the focus of this study, although it is recognized that the subjects in this study made judgments about the state of the patient.

2. Clinical Judgment Research-the Process

The cognitive processes involved in identifying patient problems are complex (Kelly, 1964; Hammond, 1964). The nurse is often required to work with incomplete data under pressures of time and other situational variables. Further, cues and signals sent by the patient are not totally dependable; that is, one cue may be found in different situations while one situation may produce many cues (Hammond, 1964). Few studies appear in the nursing literature which directly bear on the cognitive processes involved in diagnostic reasoning. Tanner (1983, 3) describes a framework by which the literature in the area can be reviewed; that is, the variables which influence both the judgment process and its outcome could be examined. The variables examined include: i) task variables, ii) contextual variables, iii) clinical variables, and iv) risk/benefit variables. The research in clinical judgment in nursing was examined using this framework.

Task variables are those which define the overall complexity of the patient situation. Contextual variables are the factors in the environment which are not immediately apparent (e.g. institutional

policies) but which may influence decision making. Clinician variables are the characteristics of the decision maker which influence the diagnostic reasoning process, while risk/benefit variables are those associated with any action chosen by the clinician.

a. Research associated with task variables

No nursing studies were found in which the amount of information and complexity of the diagnostic task were systematically varied to determine the effect on the diagnostic reasoning ability of the subjects. The present study, modelled after the work of Tanner and associates (1982, in progress), attempts to examine the effect of varied task variables such as competing diagnostic hypotheses, presence of subtle cues, imposition of a set imposed by initial cues, on the diagnostic reasoning ability of the nurse subjects (see Chapter IV-development of videotaped simulations).

b. Research associated with contextual variables

Baumann and Bourbonnais (1982) conducted an exploratory descriptive study to identify factors that critical care nurses consider relevant in making rapid patient care decisions. Fifty experienced ICU/CCU nurses identified what they would do given the particular case situation (a patient with myocardial infarction). Further the subjects were asked to rank those factors which influenced decision making in the cardiac case study. Knowledge and experience were ranked 1 and 2 by the majority of nurses. Interestingly, when asked, many of the subjects (10-45% depending on the decision) were unable to provide a rationale for the decision selected. No attempt was made in this study to identify the cognitive processes used by the nurses in their decision making, nor to

identify what cues/information in the case situation elicited the decision chosen.

c. Research associated with clinician variables

The majority of nursing studies on diagnostic reasoning have examined the influence of clinician variables on clinical judgment. Three variables will be examined in the present study: education, years of clinical experience, and method of instruction.

i) Education/experience

Aspinall (1976) investigated the ability of 187 nurses of varied educational background and experience in identifying patient problems from a written case situation. Twelve problems (10 physiological and 2 psychosocial) were contained in the case study. Across all subjects, a mean of 3.44 of the possible 12 problems were identified. Statistically significant differences existed with respect to the number of problems correctly identified between nurses with baccalaureate degrees[3] and those with associate degrees[3], and between nurses with baccalaureate degrees and diploma[3], with baccalaureate degree nurses identifying more problems in both instances.

Further, statistically significant differences existed between nurses with less than 2 years experience and those with more than 10 years experience, with the former group identifying more patient problems. This may reflect more practice, in the less experienced

[3]A baccalaureate degree program in nursing is generally a 4 year program offered through a university. An associate degree program is a 2 year program offered through a community college, while a diploma nursing program is a 2 or 3 year hospital-based program.

clinical group, with writing patient problems and performing diagnostic related activities, as these functions are receiving more prominence in nursing curricula today. Aspinall speculated about the quality of care patients receive when only 25% of the nurses identified problems other than physiological problems. Moreover, 21% of the nurse subjects failed to identify the respiratory problem found in the case study.

Broderick and Ammentorp (1979) in a three phase study of decision making which focused on initial information organization by nurses in a problem setting and the relationships between information categories or concepts and problem solving behavior, compared the behavior of practising nurses ("experts") and student nurses ("novices"). Subjects were presented with a written simulated patient problem (unspecified pain) and were requested to ask for information about the patient. The resulting categories of data elements were used for data analysis.

The results of their study demonstrated that both experts and novices share a common view of nursing data in that both groups sorted the 59 data elements of the patient problem "pain" into the same 12 categories. Broderick and Ammentorp concluded that this common view of nursing data remains constant over time given that novices and experts responded in the same manner. If experts and novices vary in their information processing behavior, according to Broderick and Ammentorp, it must be in the ways the information is used to reach problem solutions. (Or it may be that experts and novices structure and retrieve information differently.) This was borne out in the second and third parts of their analyses, when Broderick and Ammentorp found experts asked for more information in all 12 categories than did novices, and

experts asked more questions in total. Moreover experts asked for more items of information that were not available in the experimental setting. Broderick and Ammentorp concluded that the differences between experts and novice nurses with respect to problem solving behavior does not seem to come from their education but comes from experience, a conclusion that is supported in general problem solving literature (see Chi et al., 1981). Broderick and Ammentorp emphasized the need to develop a theory of problem solving which can explain how nurses use information to identify patient problems.

Two reported nursing studies had as their purpose the investigation of the relationship between logical reasoning ability and performance on components of clinical judgment. In both studies nursing students were employed as subjects. Gordon (1980) adopted scores on the Miller Analogies Test (MAT) or the Graduate Record Exam (GRE) [verbal aptitude subtest] as a measure of inferential ability. Gordon felt that the GRE and MAT Scores could be used as a predictor of nurses' ability to process information and to identify the state of the patient. Sixty graduate nursing students were asked to collect information about a patient to determine the current "state of the patient". Two information conditions were examined--"unlimited information", i.e. the subjects could ask as much information as they wanted about the patient before determining the current state of the patient, and "limited information", i.e. the subjects were restricted to 12 pieces of clinical information about the patient. Gordon hypothesized that those subjects with higher inferential ability (as measured by higher scores on the MAT or GRE) would use predictive hypothesis testing more frequently than

those with lesser inferential ability. Predictive hypothesis testing was defined as a form of multiple hypothesis testing characterized by use of contextual or non-varying patient attributes. The results of the study did not support the hypothesis for either of the information conditions. Gordon (1980) surmised that the two measures employed to measure inferential ability were not adequate measures of that attribute.

The second of the nursing studies that investigated the relationship between logical reasoning ability and performance on components of clinical judgment was conducted by Matthews (1978) and Gaul (1978). Student nurses were used as subjects in their studies. (Note: both studies were reported together in 1979.) These studies were based on the assumption that the ability to derive nursing diagnoses (which they defined as an inferential judgment made about the state of the patient), involved cognitive skills and information processing capabilities on the part of the nurses.

Matthews (1978) compared senior undergraduate (N=22) and graduate (N=26) nursing students on scores obtained on the Watson Glaser Critical Thinking Appraisal (WGCTA) and the number of correctly identified nurses diagnoses from a case study that was indicative of a patient with mental confusion. The subjects were instructed to indicate all the possible causes for the nursing diagnosis mental confusion, based on the cues given in the case study.

Results demonstrated there were no significant differences between the two student groups on their ability to think critically as measured by the WGCTA, although the graduate students obtained slightly higher

mean scores. The graduate nursing students did identify significantly more diagnoses than did the undergraduate subjects. No significant overall relationship between critical thinking and ability to derive nursing diagnoses emerged from the study. Matthews speculated that the WGCTA may not tap the type of critical thinking required to identify nursing diagnoses, since the WGCTA was scaled using college seniors.

Gaul (1978), in a study which focused on ability to use cues to form concepts compared senior undergraduate (N=18) and graduate (N=24) nursing students on scores obtained on the Concept Mastery Test (CMT) and the number of diagnoses derived from a patient case study indicative of emotional disturbance and impaired elimination. Significant correlations were found in the undergraduate sample on the Concept Mastery Test scores and cue perception in diagnosis of impaired elimination. No significant correlation was found for either diagnosis and Concept Mastery Test scores in the graduate sample. It should be noted that the mean scores obtained by both samples on the Concept Mastery Test (undergraduate sample=53.27; graduate sample=66.89) were considerably below the normative mean scores for those groups (undergraduate norm=101.7; graduate norm=119.2). The investigator reviewed the testing procedure and failed to demonstrate any technical reason for the low scores. Gaul speculated the scores obtained from her sample may reflect the poor diagnostic ability of nurses as noted by Aspinall (1979). Alternatively Gaul concludes her sample may not be a representative sample of graduate students. Given the very low scores obtained on the CMT by both samples of students, it is unlikely more than one significant correlation could have been obtained between CMT

scores and nursing diagnoses, if in fact the ability to identify diagnoses is a concept mastery task.

Matthews and Gaul (1979) discussed the overall findings of their studies. None of the subjects in either sample used all the cues available to identify each diagnosis. They concluded that the informational value of each cue used in making a diagnosis is more important than the number of cues used because none of the subjects used all the cues available, yet some nursing diagnoses were correctly identified. This suggests that certain "discriminating cues" provided more information to the nurse subjects than did the presence of "many" cues. Differences may exist within the two educational groups with respect to cue processing strategies. A further compounding variable was the years of nursing experience did not appear to be controlled for in either study, which may have affected the results.

Moreover, Matthews and Gaul identified an inverse relationship between the nurses's diagnostic ability and the number of nursing diagnoses identified such that as the number of diagnoses increased the nurse's diagnostic ability decreased. Again this may be reflective of a general inability on the part of the nurses to utilize diagnostic reasoning. Or it may be that the case studies adversely affected the subjects' ability to correctly identify diagnoses in that inter-rater reliability for identification of the nursing diagnoses was not established for either of the case studies. Further it is unclear whether the subjects were familiar with a nursing diagnostic framework. Finally, it may be that the sample in both Matthews' and Gaul's study were not sufficiently stratified with respect to expertise. Matthews and

Gaul (1979) conclude that much research needs to be conducted to study the cognitive activities of nurses as they relate to diagnostic reasoning.

Additional evidence for the effect of education on the clinical judgment performance of nurses was demonstrated by Davis (1972, 1974). Although Davis did not examine cognitive processing ability per se, she did examine the difference between clinical nurse specialists (with graduate degrees) (N=20) and baccalaureate nurses (N=20) on three dependent variables: 1) number of observations made, 2) number of actions taken based on the observations made, and 3) number of reasons given for the actions, after viewing a 16 mm. film which presented five patient care vignettes. The clinical nurse specialists performed significantly better than the baccalaureate nurses on all three variables. Subsequent analyses revealed no differences between the two groups when years of nursing experience were considered. A correlational analysis, however, did demonstrate that the greater the nurse's clinical experience (as measured by number of years), the fewer were the number of actions and reasons for actions suggested by the nurse. This was true for both groups. Davis concludes that after 3-5 years of clinical experience, "experience" is no longer a factor in determining the quality and quantity of nursing care" (1972, 534), a conclusion which may be too strong given the sample size and research questions. Further she observes the results may be reflective of a sample self-selection bias in that it may be that the most capable nurses pursue graduate education and therefore one would expect that they would perform better on the specified task.

Davis replicated the above study in 1974 with the addition of another group of subjects--20 diploma nurses. Again the clinical nurse specialists made significantly more relevant observations, suggested more relevant actions and gave better reasons for selecting the actions than did the other two groups. Further the baccalaureate nurses performed significantly better than did the diploma nurses. Moreover, the effect of clinical experience remained the same, i.e. increasing years of clinical experience was associated with decreasing level of performance. [Decline in performance was not consistent across all three groups, e.g. the "diploma nurse did not show a negative trend between years of experience and reasons given and actions taken" (1974, 154).]

Davis (1974) speculates about the quality of patient care being delivered by nurses if under simulation conditions (which she views as less stressful than the actual clinical environment) nurses' performance drops as years of experience increase. It could be argued, however, that the simulation experience may be as stress-provoking as the clinical environment since one is being more carefully scrutinized in the simulation experience. No analyses of differences among the different vignettes and its effect on diagnostic reasoning ability were conducted. Given the conclusion of Elstein and associates (1978) that there is no intraindividual consistency across problems with respect to clinical judgment, this may be an important factor.

ii) Instruction

The relationship of method of instruction and clinical judgment ability has been studied by few in nursing. Tanner (1977,1978),

employing an information processing theoretical framework, compared the effect on nursing students of an experimental method of instruction (information was presented to students in such a way that many cue-hypotheses links were formed) with a traditional method of instruction (information was presented in traditional diagnostic categories). Although the results failed to demonstrate a significant main effect in favor of the experimental method, there was some evidence that subjects used hypotheses to direct their information-seeking searches. Furthermore a small positive correlation was found between number of early diagnostic hypotheses and diagnostic accuracy. However, the main determinant of diagnostic accuracy appeared to be whether the correct diagnosis appeared in the initial set of hypotheses.

Tanner (1977) concluded that research that examined the cognitive processes of experienced nurses (as opposed to students) when faced with diagnostic tasks was required. (This view was supported by Kim, 1980) Further, it was suggested that simulations with verbal protocol content analysis, a methodology used successfully in medical diagnostic reasoning research, appeared to be a powerful methodology to tap the processes used by nurses in clinical judgment.

Instructional techniques which direct a nurse's cue-utilizing behavior and therefore hypothesis generating ability appear to improve diagnostic accuracy. Aspinall (1979) matched 30 triads of nurses on education, length of clinical experience and performance from a previous study (Aspinall, 1976) and randomly assigned each member of the triad to one of 3 treatment groups: Group A - case study only; Group B - case and list of 18 possible causative disease states; or Group C - case

study, disease state list and a decision tree which systematically guided the nurse to use cues to rule in or rule out the diagnosis. The subjects were asked to review a case study and to list, in order of likelihood, the possible causes for the patient's behavior.

Those nurses using the decision tree identified significantly more correct diagnoses than did the subjects in the second group who did significantly better than those in the first group ($p \leq 0.001$). In addition the group using the decision tree made fewer wrong diagnoses than did the other two groups, although the differences were not statistically significant. With respect to an overall accuracy index (composite score of number of correct and incorrect diagnoses) the group using the decision tree performed significantly better than did the other two groups ($p \leq 0.05$).

The effect of education and experience were also examined. Due to the small n's in some cells, no significant testing was done. With respect to educational preparation, diploma nurses made the most improvement as far as correct diagnoses when the decision tree was used, while associate degree nurses made the most improvement with the decision tree when mean number of incorrect diagnoses was examined. It should be noted baccalaureate nurses made more correct responses in all three treatment groups; but they also made more incorrect diagnoses than the other two educational groups with the exception of the associate degree nurses in Group A.

The effect of experience was also examined by Aspinall (1979). Nurses with more than 10 years experience had a lower mean number of correct diagnoses with the case study alone (a finding which supports

Davis' 1972, 1974 research), but they made the most improvement with the decision tree. Nurses with less that 2 years experience made the fewest wrong diagnoses while nurses with 2-10 years experience had the highest number of wrong diagnoses.

Aspinall noted that not all subjects profited from the decision tree and they seemed to rely more on their experience than following the tree (even if the cues available did not support their hypothesis). Further most errors were made in identifying the psychosocial problem of sensory deprivation, which may be reflective of a weakness of decision trees; that is, decision trees are more sensitive to objective data (e.g. lab results) (Aspinall, 1979).

Perhaps the most disturbing finding of Aspinall's study is that 40% (12 out of 30) of the nurses using the case study alone either had no correct answer or only one correct answer out of a possible six. Further examination of the answers from the 60 nurses who did not use the decision tree suggests that many had no clear-cut idea of the signs and symptoms associated with the diagnoses they listed. Aspinall speculated about the quality of care these nurses deliver if they have such apparent difficulty identifying possible causes for changes in the patient's behavior. She notes that the manner by which nurses are educated does not promote the type of skill development whereby information stores are thoroughly/systematically searched for diagnostic hypotheses. This is likely because the process of diagnostic reasoning is not well described in nursing, thus the need for research such as this present study.

The inability of nurses to clearly identify patient problems and to

differentiate between nursing intervention and problem identification was also noted by Hamdi (1970). A study of the effects of using a patient assessment tool (versus no tool) on the ability of the sample of nurses to identify nursing care problems, failed to demonstrate significant differences in the number of "valid" problems identified in diabetic patients by each of the groups. Both groups in identifying nursing care problems tended to specify routine nursing measures rather than "valid" problems. Again this points to the need for further research in the area of diagnostic reasoning ability/clinical judgment and teaching methods in nursing.

As noted in the discussion of the conceptual framework clinicians often used heuristic principles to simplify judgmental operations. "People rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations" (Tversky and Kahneman, 1974, 1124). Tversky and Kahneman (1974) describe three heuristics individuals use when making judgments about the likelihood of certain events occurring: 1) representativeness, 2) availability and 3) adjustment and anchoring. Biases often occur when each of these heuristics is used with the result that errors in judgment are made. For instance, Tversky and Kahneman note that "people often predict by selecting the outcome (for example, an occupation) that is most representative of the input (for example, the description of the person") (1974, 1126). Thus individuals often make judgments based on stereotypes (representativeness) even when evidence contrary to the stereotype is presented.

This observation has been replicated in the nursing literature.

Kraus (1976) in a study of the effect of pre-information on nurses' description of a patient found that nurses attended to patient characteristics evident in a film that reflected the pre-information they were given about the patient. Thus, those nurses who were told the patient was anxious selected characteristics, on a post-measurement tool, that reflected anxiety; while those nurses who were given disease state information selected characteristics associated with the disease state. These differences occurred even though all subjects viewed the same film and were given the same post-film measurement tool. Caution should be exercised with respect to the conclusions of this study for as Tanner (1983, 18) noted "only two empirical referents of 'directed observation' were examined in this study-rating of confidence and of importance. Further investigation is needed on strategies used to narrow the scope of information gathering, including the influence and use of pre-information".

Bailey and Swenson-Feldman (1982) reported a similar representativeness bias in a study conducted to determine if the nursing process in a VA medical centre was operationalized by surgical nurses in their nursing verbal communication through nursing reports. A data collection tool was developed to identify categories that corresponded to steps of the nursing process. Data collectors completed the tool while attending nursing reports. An average of 11 nursing process statements per patient were communicated in the combined day/night reports.

One of the reported findings was that patient care elements not specifically associated with a service speciality were not routinely

reported, (no further data was provided). Presumably this could mean that nurses working with patients with urinary problems tended to focus on that data, while nurses working with patients with abdominal surgery tended to focus on that data. The implication of this finding is that significant patient information may be overlooked by the nurse, which could lead to misidentification of patient problems.

Bruce and Snyder (1982) summarized the patterns of diagnostic errors made by nurses that have begun to be identified in the nursing literature:

> 1. premature closure...diagnosis is based on an inadequate data base.
> 2. lack of closure... adequate data are collected but a diagnosis that is present is never made.
> 3. invalid data clustering...diagnostic errors occur due to the assumed relationship of unrelated data.
>
> (Bruce and Snyder, 1982, 646).

As noted by Tanner (1983), nurses likely use certain strategies to direct information searches in their contacts with patients. It behooves the profession to more clearly identify how these searches are executed so that errors of judgment can be minimized.

d. Risk/benefit variables

Only one nursing study was found in the literature which examined the effect of risk/benefit analysis on the decision making ability of nurses. Grier (1976), using a utility theory frame-work, examined the extent to which nurses' subjective ("intuitive") decisions with respect to selected case studies were in agreement with the decisions made using quantitative techniques ("expected values").

Subjects were asked to read four case studies and to rank order 3

nursing actions per case (best to worst). Subjects then estimated the probabilities of occurrence of the 7 listed outcomes related to the risk/benefit for each of the 3 actions chosen (a total of 21 decisions per case). Further subjects were to assign a value (0-100) to each of the 7 outcomes listed (with the total score equalling 100). A total of 185 decisions were analyzed.

Nurses chose nursing actions that had the highest expected value (a quantitatively derived preferred action) for 109 of the 185 cases (58.9%). The amount of agreement was statistically significant for 3 of the 4 cases. That is, the actions ranked first by the subjects were consistent with the probabilities and highest expected values the subjects assigned to the listed outcomes in 58.9% of the cases. In addition the correlations between the rank orderings of the intuitively derived actions and those actions derived quantitatively were statistically significant for all four cases. Grier concluded that nurses use a systematic and objective process to make decisions in most cases and "decision theory is applicable to nursing" (1976, 109).

Tanner (1983) offers a criticism of Grier's conclusions. She notes that it may be premature to assume that the decision model described by Grier can be applied to nursing given the fact Grier did not determine whether the chosen action (either "intuitive" or "quantitative") would in fact result in the listed outcome. Tanner (1983, 11) notes that nursing at this stage of its development lacks "sufficient scientific base to predictably link outcomes to actions." Given that only a small majority (58.9%) of the intuitive decisions matched the quantitative decisions, one cannot conclude that either decision was better in terms

of patient outcomes. Finally, Grier stated the purpose of her study was to examine the process of making a decision. She further notes that decision making in nursing occurs in an open system, that is, the nurse never has complete knowledge about all the variables that may impinge on patient care. Yet her study sets up a closed system in that a list of actions and outcomes are presented to the decision maker. Can one infer from this the process of making a decision when it may be totally different from that which occurs in the real world? Grier presents no evidence to suggest that decisions reached by intuitive processes are less rational than those reached by the statistical model. It may be, as Sober (in Englehardt et al., 1979) suggests that not enough is known about so-called intuitive decision-making.

In addition, although many studies (e.g. Aspinall, 1979; Grier, 1976; Hammond and associates, 1964, 1966) indicate that "performance of clinical decision makers does not match that prescribed by the statistical model" (Tanner, 1983, 12) it seems that information processing theory, the framework on which the present study is based, more than utility theory or decision theory, takes this into account. For information processing theory recognizes that humans are often illogical in their behavior (Tierney, 1983) and, as Tversky and Kahneman noted, human decisions are influenced by biases (Tanner, 1983).

3. Clinical Judgment Research: Hammond and associates

In a now classic series of studies, Hammond and associates (1964, 1966, 1967) were among the first researchers to study clinical judgment in nursing. Beginning with the observation that little was known about the specific kinds of inferences nurses made, Hammond and associates

attempted to describe the ways nurses use information in making clinical inferences. In addition, Hammond and associates were among the first researchers in clinical judgment research to recognize that traditional research methods (e.g. classical experimental design) were not fruitful, at that time, in studying clinical judgment.

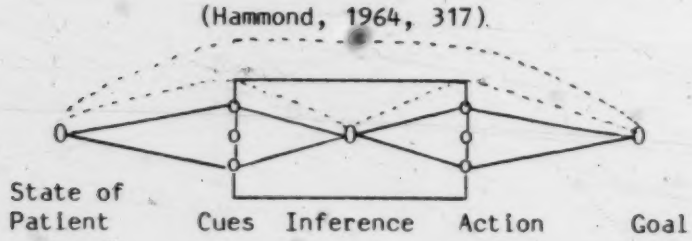
The complexity of the task nurses face when making clinical judgments is evidenced by the fact that Hammond and associates'(1964) initial research purpose could not be achieved. Initially, they wanted to select five "states of patients" which could be verified by objective criteria (e.g. lab/x-ray findings) and to quantify the relationship between the state of the patient and various cues which signify the state. No state of the patient was found, after interviewing patients and nurses, reviewing literature, talking with experts, attending conferences, which did not depend on some type of subjective judgment for verification. The Hammond research team moved on to examine the kinds of inferences nurses make about patients, what cues they use to identify those inferences and what actions nurses take based on those inferences.

The research was based on the lens model theory of decision making. That is, there exists a state of the patient which is unknown to the nurse until the nurse infers this patient state by recognizing and interpreting the cues the patient displays. The relationship between the cues and the patient state are probabilistic and uncertain. Further, the relationship between the action and goal is uncertain and probabilistic. (See Figure 2.)

Figure 2

Application of Lens Model to Clinical Inference

(Hammond, 1964, 317)



The first field study (1966a) was a 24 hour ecological survey of the kinds of nurse-patient situations encountered by 47 graduate nurses. A total of 381 detailed nurse-patient descriptions emerged from that study. Hammond and associates concluded they needed to be more specific with the state of the patient and more broad with the sample; thus field study II (1966b).

Professional nurses from 30 hospitals in 12 states provided the researchers with 212 detailed descriptions of nurse-patient situations of patients experiencing post-operative abdominal pain. At least seventeen actions were taken in the 212 cases of post-operative abdominal pain. These actions were categorized into four action categories: environmental system, patient's physical system, patient's surface and the patient's psychological system.

Further analysis by Hammond and associates revealed many different signs and symptoms available for use by nurses when evaluating patients' complaints of pain. Moreover, "no single cue transmitted a significant amount of information to the field nurse, with respect to the 15 categories used...The cognitive tasks encountered by nurses...are many and varied...Even when a relatively narrow segment of the nurse's task

environment is studied, a large amount of complexity is encountered" (1966c, 138).

In field study III Hammond and associates (1966d) randomly selected 100 patient descriptions from the 212 situations identified in field study II. Six nurses were presented with these cases and were to infer the state of the patient from the cues provided. Information theory analysis was conducted to identify the single cues and/or cue groupings, if any, that made up a message unit. The researchers were unable to identify the message units of various cognitive tasks in nursing. No single cue conveyed more than a small amount of information to the nurse subjects. Nor were groups of cues, arranged in various ways, related to the inferences made by nurses about the state of the patient. This included groupings of cues arranged by textbook-related groupings. [It would seem, as Tanner (1983) notes, that although nurses are traditionally taught various message units about disease categories, e.g. signs and symptoms of diseases, this information was not incorporated, in the Hammond studies, into the decision making strategies of the subjects.] Finally, the nurses did not discriminate among the usefulness of cues (the nurse subjects tended to say all cues were "very" or "extremely" useful). nor did the subjects express confidence about the appropriateness of the decisions they made.

Hammond and associates (1966d) cite methodologic flaws with the research design employed in this series of studies. For example, cases given to the nurses may not be representative of the cognitive tasks encountered by nurses. Yet, as the researchers point out, these flaws most likely are not sufficient justification to account for the result

that if basic message units are common knowledge in nursing, their subjects did not recognize them and/or did not use them. Hammond and associates conclude that more research needs to be conducted concerning the cognitive tasks and message units used by nurses in their clinical practice.

Additional studies by Hammond and associates (1966e, 1967) demonstrate that nurses do not use the same information seeking strategies across cases or among themselves. In addition the subjects did not pursue a perfect information seeking strategy. That is, the order in which cues were selected did not correspond perfectly with the probability estimates of the information value of the cues selected.

This series of studies made an important contribution to the study of clinical judgment in nursing. "The recognition of the complexity of the judgment process, the identification of variation among subjects and the provision of a beginning framework for analyzing task complexity" (Tanner, 1983, 6) are among the significant contributions made by Hammond and associates.

D. Clinical Judgment Research: Medicine

There has been more research about clinical judgment in medicine than in nursing. This is no doubt due, in part, to the more explicit function of diagnosis in the discipline of medicine. Only relatively recently has the diagnostic task (i.e. judgment) received attention in nursing research, as described in the earlier section of this literature review. Schneider (1965) noted that the nursing inference task is different from the physician's inference task. He perceived nurses infer and treat secondary symptom sets (presumably such things as pain,

sensory deprivation, etc.) while physicians infer and treat primary symptom sets (e.g. disease conditions). Moreover he observed that physicians are typically trained about the uncertain nature of the decision tasks (this assertion is perhaps open to debate--see, for example, Kassirer, 1976), while nursing texts do not identify as clearly the complexity and uncertainty of the diagnostic task in nursing.

This latter assertion is becoming less correct given the recent nursing texts which acknowledge and identify the complex diagnostic tasks in nursing (see Carnevali, 1983). Despite these apparent differences between the diagnostic tasks of medicine and nursing, it is felt that nursing can learn from the research conducted in medicine and psychology. In fact many authors, as previously noted, assume the diagnostic process is the same for nursing as medicine. This assertion will be explored in the present study.

The most extensive research of clinical judgment in medicine using an information processing theory perspective is the work of Elstein and associates (1972, 1976, 1978). A model of medical problem solving emerged from the work of Elstein and associates. This model formed the theoretical framework of this study.

Using a group of 24 physicians--17 criterial (nominated by 5 or more peers as expert diagnosticians) and 7 non-criterial physicians (received less than 5 votes) and 3 "high fidelity" simulations employing trained actors, Elstein and associates used periodic thinking aloud procedures with simulated recall methods as the physicians conducted diagnostic workups and attempted to diagnose the "patient's" medical problems. Twelve dependent variables were analyzed to meet the study objectives.

A wealth of information emerged from this first study. The results of this initial study are summarized as follows: (Elstein et al., 1978)

1. A general model of diagnostic inquiry includes the following:
   a. cue acquisition: this seems to depend on routinized knowledge of physical exam and history taking.
   b. hypothesis generation: this involves retrieving limited numbers of hypotheses from LTM and using these to establish the problem space.
   c. cue interpretation) this is related to acquired
      hypothesis evaluation) processes stored in memory.

Elstein notes this model reflects the learning/generalization nature of this model and not the innate abilities/personality of the problem solver.

2. Diagnostic hypotheses were generated by physicians very early in the workup. More than 80% of the sample generated at least one hypothesis in all simulations, with 95% generating the first hypothesis within the first 5 minutes in simulation 3. Each hypothesis accounted for some of the initial data base.

3. Across all three simulations, it was noted that medical diagnosis did not proceed in a strictly inductive fashion but hypothetico-deductive processes were used by all physicians. Moreover, the structure of medical problems was complex and varied. Some problems were handled by generating specific hypotheses early while other problems were best handled by a systematic progression from general to specific hypotheses.

4. In contrast to Elstein's interpretation of an earlier study

(1972) specific hypotheses are not generated early in the diagnostic workup in all the simulations. Rather some hypotheses are general in nature. This phenomenon seems to be problem specific not physician specific.

5. There is a limit on the number of diagnostic hypotheses that can be concurrently evaluated. A range of 4 to 7 hypotheses can be entertained at one time, according to the results of the Elstein studies.

6. There was no evidence of statistically significant intraindividual consistency among subjects across problems. That is, the ability to solve the problem seemed to depend on the nature of the problem rather than the individual's problem solving style. (Note: problem solving style was not defined). Excellence in problem solving is both content and process dependent and "assessing clinical competence is complex, and multiple measures will be required" (Elstein et al., 1978, 86).

7. In general there was no statistically significant difference between criterial and non-criterial physicians on five dependent variables: point of generation of the first hypothesis, total number of hypotheses generated, percentage of cues acquired, efficiency and accuracy of interpretation. The one exception was that criterial physicians asked more questions before generating their first diagnostic hypothesis in simulation two (the most difficult simulation). Elstein and associates conclude this result offers further support for the notion that performance on medical problem solving tasks tends to be highly problem specific and that the process measures used do not

"especially reflect the underlying individual consistency in approach to problems." (1978, 88). Tanner (1983) suggests this finding may be accounted for by the relative homogeneity of Elstein's sample. Although there was no statistically significant difference between criterial and non-criterial physicians some trends did emerge--criterial physicians tended 1) to ask more questions before generating the first hypothesis, 2) to collect a few more cues, and 3) to interpret data with slightly more accuracy.

8. When examining the accurate (N=8) (accurate = correct diagnoses on all 3 simulations) with the inaccurate (N=11) physicians, the accurate group was not made up exclusively of criterial physicians (6 criterial and 2 non-criterial) which suggests perceived competence does not equal actual competence, with competence defined in terms of accuracy.

9. Physicians spontaneously used a three point weighting system to evaluate data for each hypothesis--postive, negative and noncontributory. These physicians did not use a Bayesian decision model nor lens model to diagnose the problems, which seems to suggest that these physicians did not intuitively employ those approaches in making decisions. (Note: these physicians were untrained in any formal method of problem solving/decision making).

10. Thoroughness of cue acquisition and accuracy of cue interpretation among the physician subjects were both statistically independent variables. Moreover diagnostic accuracy was related to both thoroughness of cue acquisition (although only weakly associated, notes Elstein, 1978, 108) and accuracy of cue interpretation.

11. Three types of errors occurred during the process of cue interpretation: over-interpretation of cues (the most common error), under-interpretation and misinterpretation. Additional errors included excessive data collection and leaving some cues uninterpreted.

12. Elstein and associates found no significant correlation between tests of logical problem solving and clinical problem solving. In addition there were inconsistent associations between personality variables and clinical problem solving. The authors conclude personality may not be as critical a variable in clinical problem solving as once thought, or at the least, personality variables do not seem to generalize across problems.

Elstein and associates concluded that diagnostic competence is not a unidimensional construct. (This is supported by Vu's review of the literature, 1980, 453). Further, contrary to popular belief, problem solving ability seems to depend more on the nature of the clinical problem and not necessarily on the processes used by the problem solver.[4] Thus the importance of the research of Tanner and associates (1982, in progress) which examines the diagnostic reasoning activities of many nurses as they attempt to identify different types of problems related to patient care.

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[4]This view is supported by Bashook (1976) who notes that problem solving is defined by 3 dimensions: 1) the problem solving process (problem sensing, problem defining and problem management), 2) clinical discipline (he hypothesizes that there are distinctions among medical clinical specialities with respect to problem solving behavior), and 3) context of care (e.g. acute, chronic, emergency, etc.). Successful performance in one domain is not necessarily transferrable to another domain. To this writer's knowledge, this model of clinical problem solving has never been tested.

The results of Elstein and associates studies' as they relate to the high fidelity simulations have been criticized with respect to the clinical reasoning measures used, data analyses and the diagnostic inquiry model employed in the research (McGaghie, 1980). McGaghie notes the authors did not report how the dependent variables were derived from the fundamental units of analysis (i.e. information search units, cues, hypotheses) nor was there "convincing evidence" (McGaghie, 1980, 915) to show the variables were reliably measured. The data analyses methods were also called into question given that the small sample size of twenty-four physicians precluded the use of factor analysis. The results of those criticisms, according to McGaghie, suggest the "validity of the diagnostic inquiry model has not been established because the empirical observations it yields are not faithful to its origins." (Mcgaghie, 1980, 920). He suggests further studies should employ a broader and more representative sample of cases to elicit the diagnostic reasoning process, and that different approaches to data analysis be used.

Although critical of the research methods used in the Elstein research, McGaghie (1980) offers no better method to attempt to elicit the diagnostic reasoning processes of clinicians. One criticism McGaghie makes is the low correlations among dependent variables in each of the three simulations and Elstein's subsequent conclusion that the structure of the problem influences problem solving more than does individual problem solving style, is somehow incongruent. Given the results of general problem solving research (see for example Larkin, McDermott, Simon and Simon, 1980) which suggests that success in problem

solving seems to depend on adequate representation of the problem in the problem solver's memory and subsequent retrieval of information related to that problem, it is not surprising there may be intraindividual inconsistency among problem solvers. Elstein and associates noted that the three simulations were very different with respect to ease of problem solution, and the clinicians used different approaches when faced with each simulation.

Tanner addressed the issue of a broader and more representative sample of cases to elicit the diagnostic reasoning process in nursing, by preparing eleven videotaped simulations representative of "both diagnostic content typically encountered in hospitalized patients and the kinds of strategies needed to derive the most probable diagnosis" (Tanner et al., 1982, 6). Reliability and validity of the simulation used in the current study was assessed using a variety of techniques (see chapter 4). McGaghie's criticism is well taken, given that validity of the data suffers to the extent that components of the diagnostic reasoning process cannot be reliably measured. Studies, such as the current research described herein, will further improve the data collection techniques and thereby increase the quality of the data.

In a second study of diagnostic reasoning, Elstein and associates examined the problem solving processes of 15 of the 24 physicians from the original study on completion of 4 patient management problems (PMP). A PMP begins with a brief introduction about the patient. The examinee decides how to proceed with the workup by selecting one response from a list of possible responses. This response leads to further instructions until a diagnosis is reached. Hypothesis

generation occurred early with data selected according to the hypothesis generated (Elstein et al., 1978). Again Elstein found that intraindividual consistency across problems was low. How the problem solver set up the task environment seemed to influence how the problem was solved. Three types of errors occurred: inaccurate hypothesis generation, errors made in evaluating a hypothesis (e.g. rejecting an accurate hypothesis) and misinterpretation of data.

The finding of early hypothesis generation in diagnostic problem solving has been substantiated in many other medical studies. Allal (1973, in Elstein and associates, 1978, chapters 7 & 8), using a 16 mm filmed patient simulation and verbal protocol analysis with thinking aloud, found that 96% of the 8 physician subjects generated a diagnostic hypothesis no later than 1 minute after viewing the film simulation. Sprafka (1973, in Elstein and associates, 1978, chapter 9), employed an experimental design to study the effects of verbalizations on both diagnostic approach to a problem and the quality of the diagnosis. Thirty fourth year medical students, randomly assigned to one of 6 groups, solved 3 PMPs. One of the groups was specifically instructed to withhold judgments about the diagnostic hypothesis until all the data were collected. She notes, "despite exhortations to the contrary and regardless of the nature of the problem, subjects tend to generate the first hypothesis based on a small number of data." (p.242). Sprafka also found that the process of problem solving was task specific not problem solver specific.

Kassirer and Gorry (1978) studied six clinicians completing a diagnostic workup, using a simulated patient and a thinking aloud

procedure. They also found physicians generated hypotheses very early with few cues. Further, clinicians could only maintain 4-11 hypotheses at one time in their working memory.

Kassirer and Gorry noted hypothesis activation seemed to be related to both knowledge of problem solving methods and extent of knowledge of disease entities. It was the latter which stimulated hypothesis activation and directed search for further cues. Moreover this information gathering was hypothesis driven and not merely a systems review. Hypothesis evaluation, which occurred later in the diagnostic workup, was based on "case building", i.e. adducing evidence to support the hypothesis.

Interestingly, Arkes and Harkness (1980), in a series of experiments designed to investigate the effect of possessing a diagnosis on subsequent recognition of symptoms, reported the following:

1) Subjects tended to falsely recognize previously unpresented symptoms if they were related to a diagnosis previously made.

2) Despite the loss in recognition accuracy there was a gain in other aspects of accuracy in that "compared to those not given the diagnosis, subjects given the diagnosis more accurately recognized symptoms seen before and more accurately rejected new symptoms unrelated to the diagnosis." (Arkes and Harkness, 1980, 568).

3) When there was an inconsistent symptom in the original set of symptoms, the group of subjects who had been given the diagnosis performed more poorly than did the no diagnosis group in the recognition tasks. The authors concluded that overconfidence in validity of one's hypothesis is not uncommon and may be related to biased memory for

evidence. Thus, they suggest, diagnosticians should write down symptoms observed (when examining patients) so as to increase the accuracy of diagnosis.

Finally, Vu (1980) in a comprehensive review of the literature on medical problem solving, summarizes the research when he writes that effective medical problem solving is characterized by generation of specific hypotheses early in the encounter with the patient, and use of both specific search strategy and of specific questions to elicit critical findings. Further, efficient problem solving appears to depend on the individual's acquired problem solving skills and knowledge of the problem to be solved. He concludes there still exists a lack of understanding about the processes and skills inherent in medical problem solving. Additional research with objective data is required "as long as problem solving ability remains important for optimal functioning of a clinician "(Vu,1980, 455).

"Our understanding of the gross diagnostic strategies [in medicine], is, at the moment, quite fragmentary" (Kassirer and Gorry, 1978, 255). If such understanding is fragmentary in medicine, then it is chaotic in nursing, where only recently clinical research in this important area has been undertaken. Such research can offer a great deal to the development of the science of nursing and to a greater understanding of diagnostic reasoning strategies in general.

E. Problem Solving Literature

The relatively new discipline of cognitive science (Norman, 1981; Norman and Rumelhart, 1975) "deals with how people perceive, represent,

remember and use knowledge" (Norman and Rumelhart, 1975, 3). Given the importance of recognition, storage and retrieval of information in diagnostic reasoning tasks (Tanner in Carnevali, Mitchell, Woods and Tanner, 1984; Feltovich, 1981) a brief review of the problem solving literature in general has much to offer the study of diagnostic reasoning. Such a review follows.

As noted in the conceptual framework, internal representation of the problem by the problem solver determines success (Chi et al., 1981) with a "good" internal representation, therefore, facilitating ease of problem solution. Moreover, problem representation appears to depend on both adequacy of domain related knowledge in the memory (Larkin et al., 1980). With respect to the latter variable, Larkin and associates (1980) suggest that information in the long term memory is most likely represented by a "complex organization of nodes, connected by links" (1981, 1337). Objects and components of objects correspond to the nodes with the relationship between objects corresponding to links.

Domain related knowledge in cognitive science is most often studied by comparing performance of "experts" and "novices" in a variety of problem solving tasks. As noted by Larkin and associates (1980, 1336) "expertness probably has much the same foundation wherever encountered" which suggests that research findings from general problem solving studies could have applicability to problem solving tasks in nursing.

Chi and associates (1981) compared the performance of experts and novices on a variety of physics problems. They concluded that although there was no quantitative difference between the two groups on sorting of physics problems (i.e. both groups sorted the given tasks into

virtually the same number of sorts) there was a qualitative difference between the two groups. Experts took longer than novices on the first trial of problem sorting (18 minutes versus 12 minutes). They speculated this occurred because experts study the problems in greater depth and searched their memory stores for similar schema by which to categorize the problem. Larkin and associates (1980) in another study of physics problems found experts solved simpler problems in one-quarter of the time of novices and with fewer errors. However, with more complex problems, experts took longer than novices. Thus it may be that one should not necessarily expect expert problem solvers to solve problems more quickly than novices, particularly if the problem is a complex one.

In addition, Chi and associates (1981) note that experts, when "reading" a problem, formulated a hypothetical solution very early which was then followed by extraction of information which confirmed or rejected the hypothesis. This model is not unlike Elstein's model of diagnostic inquiry in medical problem solving and gives support to the notion that problem solving skills, in general, are generic across disciplines.

In a series of studies of performance of chess players deGroot (in Chase and Chi, 1981) observed that expert and novice chess players used the same search strategies when analyzing chess moves. However, expert chess players have a more extensive store of representations of chess moves which they recognize and subsequently act on. This observation has been replicated in a number of studies (Chase and Chi, 1981; Feltovich, 1981; Larkin et al., 1980; Chiesi, Spilich and Voss, 1979)

with a number of different tasks (e.g. bridge playing and physics problem solving).

In a different type of chess task, de Groot presented masters and non-masters chess players with various chess positions for brief intervals of time (5-10 seconds). Masters players could recall the positions almost perfectly from memory, while the non-masters players had considerable difficulty with this task. The masters' ability was not related to superior visual short term memory because both groups were equal in their ability to recall randomly placed chess pieces. This evidence led de Groot to conclude that Masters' players recognized familiar patterns of pieces as a result of extensive exposure to such patterns.

Chase and Chi (1981) confirmed this result when they reported, following a review of the literature on problem solving, that expertise in problem solving is acquired through practice. Repeated practice of the skill appears to accomplish two things; 1) it leads to a store of patterns (or problem representations) in the memory and 2) it facilitates the acquisition of problem solution strategies on the part of the problem solver. It would appear, therefore, that all things being equal, increasing years of experience in a given situation should increase expertise in that area. This runs contrary to the findings of Davis (1974, 1972) who reported that nurses' ability to make observations from filmed sequences, to suggest relevant actions and to give reasons for those actions, decreased with increasing years of experience. A possible explanation is the tasks being measured were not specific to the clinical experience of the subjects. Chase and Chi

(1981) and Feltovich (1981) observed that skill acquisition (in problem solving tasks) is very specific. That is, it is not possible to predict performance on complex perceptual motor tasks (e.g. tennis) by looking at performance on simpler components of the task (e.g. eye-hand coordination). Further, they note there does not appear to be much theoretical justification for differentiating perceptual-motor and cognitive skills, therefore, their observations on perceptual motor tasks could be applied to diagnostic reasoning skills, given that this is a cognitive activity.

In a series of problem solving studies related to baseball, Chiesi and associates (1979) concluded that experts ("high knowledge" subjects) were more sensitive to changes that were important to the game of baseball than were novices ("low knowledge" subjects). Further, although recognition performance between the two groups was not significantly different, high knowledge subjects required less information to make a judgement. As well, recall of previously presented information was facilitated by cuing, more for the high knowledge group than the low knowledge group. If one thinks of presentation of symptoms by a patient as cues, then diagnosticians with high knowledge related to that diagnosis, should be more apt to make the correct diagnosis, and with less information, than those with less knowledge.

In summary, a brief review of the literature on problem solving skills from a cognitive science perspective suggests the following: "Problem solving in a rich knowledge domain begins with a brief analysis of the problem statement to categorize the problem" (Chi et al., 1981,

150). Further expert diagnosticians represent particular cases by general categories, which then facilitates formation of diagnostic hypotheses (Chi et al., 1981).

With respect to expertise in problem solving, knowledge in a given domain facilitates acquisition of new domain related knowledge (Chiesi et al., 1979). Success in problem solving appears to be dependent on pattern recognition and rapid access to a large sort of problem representations (patterns) in the problem solver's long term memory. As Larkin and associates (1980, 1342) noted, "an expert [in physics problem solving] is not merely an unindexed compendium of facts" but is an individual who is able to use pattern indexed schemata to access information. They speculate this may account for so-called "intuition" in problem solving tasks whereby an expert problem solver can often arrive at a solution to a problem without much apparent thought.

F. Summary

This literature review examined the nursing process model as a framework to be used by clinical nurses to direct patient care. In addition the clinical judgment research in both nursing and medicine was examined.

With respect to the nursing process model, it appears inconclusive whether that model best represents the complex task of nursing. Some theorists (e.g. Tanner, 1984; Carnevali, 1984) note the nursing process model is too linear in its approach. That is, the nurse is directed to gather all data before proceeding to problem identification, developing an appropriate plan and implementing and evaluating that plan. As an

alternate approach to the process of clinical judgment, the diagnostic reasoning model has been advanced as one that is common to all clinical practitioners (Carnevali, 1983) and one that is more reflective of the complex task of nursing. It remains to be seen, however, whether the diagnostic reasoning model of clinical judgment is applicable to nursing for that model is only now being tested (Tanner, 1982, in progress).

After reviewing the nursing literature on nursing diagnoses from a nomenclature point of view, it is evident there are difficulties with the task of labelling nursing diagnoses and identifying their component parts (etiology and critical defining characteristics). For this reason, the focus of this study was to examine the cognitive processes involved in making diagnostic judgments in nursing. It is recognized that although nurses in the present study identified nursing diagnoses, emphasis was not placed on identifying the critical defining characteristics or etiology of those diagnoses but was focused on the cognitive skills employed by nurses as they proceeded through a diagnostic workup.

A review of the limited literature that exists in clinical judgment in nursing suggests nurses have difficulties identifying patient problems from written case studies (Baumann and Bourbonnais, 1982; Gordon, 1980; Matthews and Gaul, 1979; Aspinall, 1976). Moreover, although psychological literature on problem solving suggests practitioners should become more adept at identifying and solving problems with increasing years of clinical experience (Feltovich, 1981), the nursing literature suggests the opposite finding (Davis, 1972, 1974; Aspinall, 1979). It may be that the more experienced nurses were not

familiar with the tasks of identifying patient problems as this skill has only recently been introduced into nursing curricula (Carnevali, 1983). As Aspinall (1979) suggests diagnostic reasoning skill development has not been extensively promoted in nursing education.

The majority of studies of clinical judgment in nursing did not examine diagnostic reasoning per se. Further, many studies utilized nursing students as the study population (Gordon, 1980; Matthews and Gaul, 1979; Tanner, 1977; Davis, 1972). Less emphasis has been directed to studying the cognitive processes expert nurses use when identifying patient problems amenable to nursing intervention. This was the focus of the present study.

More research in diagnostic reasoning has been conducted in medicine. Elstein and associates (1978) in an extensive series of studies of diagnostic reasoning behavior in medicine formulated a model of diagnostic reasoning: the practitioner gathers or collects data, generates initial diagnostic hypotheses based on the data, gathers and interprets more evidence to support or refute the hypotheses, and finally, reaches a diagnostic decision. Further evidence for the existence of this model of medical diagnostic reasoning has been provided in studies by Kassirer and Gorry (1978); Allal (1973, in Elstein et al., 1978) and Sprakfa (1973, in Elstein et al., 1978). Vu (1980), after a comprehensive review of the literature in medical problem solving, also concludes this model of diagnostic reasoning seems to be the approach medical practitioners utilize in clinical problem solving. In addition he notes that efficient problem solving appears problem specific and is related, in part, to clinical experience. Vu

concludes there still exists a lack of understanding about the processes and skills inherent in medical problem solving. This lack of understanding is even more pronounced in nursing.

G. Tanner and Associates Research (Ongoing)

In an attempt to examine the diagnostic reasoning strategies of nurses, Tanner and associates (1982, in progress) conducted a research study using the Elstein model of diagnostic reasoning. In addition Tanner and associates employed a similar methodology to Elstein's--introspection and analysis of verbal protocols--to identify diagnostic reasoning strategies of nurses. The overall purpose of Tanner's study was "to explore the extent to which the model of diagnostic reasoning describes the processes used by nursing students and practicing nurses" (Tanner et al., 1982, 1).

Forty-three subjects [N=15 junior nursing students (J), N=13 senior nursing students (S), and N=15 practicing nurses (RN)] formed the study sample. Two instruments, a written examination to assess cognitive knowledge and 9 videotaped simulations, were employed. (See chapter four for an expanded discussion of the instruments and study procedure.)

The testing procedure was conducted as follows: the subjects completed the written examination approximately 2 weeks prior to completing the thinking aloud procedure. With respect to the videotaped simulations, each subject was tested individually and was trained in the thinking aloud procedure using 2 training simulations. In total 11 simulations were viewed by each subject in 3 different sessions (3-4 simulations/session). After receiving an oral nursing report, during

which the subject could take notes, each subject immediately viewed the videotaped simulation. The subject was instructed to seek the kind of information (e.g. physical exam data, lab data) from the examiner she/he would in the actual clinical situation. A maximum of twenty minutes was allowed to complete the workup. As subjects asked for information, they were prompted to think aloud describing their interpretation of the data as they proceeded. The thinking aloud protocols were tape recorded and transcribed for subsequent analysis.

Although data analysis is still ongoing, some preliminary data are available from an analysis of the transcripts related to simulation #10[5]. A total of 310 inferences were generated by all subjects on simulation #10, with an average of 7.2 inferences/subject and a range of 2-15 inferences/subject. Results on the written examination were as follows (maximum score possible: 29): junior nursing students -$\bar{X}$:14.8; senior nursing students -$\bar{X}$:20.6and practicing nurses - $\bar{X}$:21.8. With respect to cue utilization, junior nursing students used an average of 8.6 cues in total, senior nursing students used an average 8.46 cues, while practicing nurses used an average of 8.6 cues across all inferences generated. No statistically significant differences have been found among the sample groups with respect to the number of hypotheses considered (averages: J=4.93; S=4.38; RN=5.60) or the accuracy of hypotheses generated (average number of accurate hypotheses: J=1.47; S=1.23; RN=1.80), although the trend suggests the practicing

[5]Results provided by Dr. Tanner and associates on January 18-20, 1984. These data are not for publication without permission of Dr. Tanner.

nurse group considered more hypotheses and were more accurate than the nursing student groups.

Possible explanations advanced for these results include the following (Padrick et al., 1984): 1) the written examination may not have tapped all components of cognitive knowledge essential to the task at hand; 2) more differences may show up with subsequent analyses of the other vignettes; and 3) the testing procedure did not stimulate sufficient thinking aloud behavior.

In an attempt to refine the testing procedure, the present study replicated Tanner and associates' study, in part, using the introspective methodology with verbal protocol analysis with simulation #10 (see further description in the methodology section). Some modifications were made to the testing procedure in an attempt to increase the subject's thinking aloud behavior and thereby to increase the quality of the data. These modifications included the following:

1. Three simulations (instead of the two Tanner used) were used to train the subjects. After each simulation was viewed and the thinking aloud protocol was audiotaped, the process was reviewed with the subject to provide subject feedback (e.g. points in the procedure where the subject seemed to be thinking but not verbalizing).

2. The subjects were asked to think aloud once they had heard the nursing report and before they viewed the videotaped simulation.

3. Reference material (e.g. normal lab values, drug compendia) were available to the subject if she/he requested such information. Such materials were not visible to the subject so as not to cue the subject. Tanner and associates did not use such reference material and she noted

the subjects frequently said such things as "if I had the drug compendium I would look up the side effects of _____". If the purpose of the simulation is to represent reality then reference material normally available in a clinical setting should be available to the subjects. In further support of this, McGuire, Solomon and Forman (1976) added a section of standard lab values to their revised medical problem solving simulation exercises so that normal lab values could be referred to by individuals completing the exercises.

4. The subjects were not limited in the amount of time they took to complete the diagnostic workup.

5. The criteria for expert clinicians were expanded to assist the unit supervisors to identify those practicing nurses whom they considered to be expert clinicians.

6. The written examination was administered after the verbal protocols were completed so that the subjects were not cued to the content of the videotaped simulations.

"Safe and effective patient care rests, in large part, on the clinician's ability to gather data and to use his/her knowledge in the recognition of health problems and in the development of an appropriate plan of care. Despite the importance of assisting clinicians to develop such problem solving abilities, there are virtually no reasearch-based strategies for instruction in diagnostic reasoning processes. A necessary prerequisite to the development of instructional methods is systematic analysis of the problem-solving processes, detailing <u>how</u> expert clinicians proceed in their thinking from clinical data to

diagnosis to management" (Tanner and associates, 1982, 1). It was the purpose of the current study to attempt to identify these processes.

CHAPTER FOUR

RESEARCH METHODS

A. Research Questions and Definitions

The following research questions formed the basis of the current study:

1. What kinds of inferences do registered nurses employed in an acute care setting generate based on presentation of a videotaped patient simulation and a simulated nursing report?

2. What cues do registered nurses employed in an acute care setting use to identify the inferences described above?

3. When in the diagnostic process are the inferences described in Question 1 activated?

Definitions

inference: A conclusion or judgment made by a registered nurse, on viewing a videotaped, simulated nurse-patient encounter, about the state of the patient. An inference goes beyond the information or data present in the videotaped simulation or nursing report (Kelly, 1964). An inference is a "word, phrase or statement descriptive of a patient's health disturbance and explanative of signs, symptoms or other data." (Tanner, 1977, 93).

state of the patient: "a covert condition of the patient which is not directly observable to the nurse" (Kelly, 1964, 315). The nurse must make a judgment or inference about the state of the patient based on cues present in the patient's environment. This can include both signs

in the patient observed by the nurse or symptoms expressed by the patient.

registered nurse: An individual who meets the criteria of the Nursing Profession Act (Statutes of Alberta, 1984) who is currently employed full-time on a medical or surgical unit of an acute care facility and who has been nominated by his/her unit supervisor as an expert clinician.

acute care setting: A tertiary care treatment facility for adult patients.

patient simulation: An alternative or substitute for an actual nurse-patient encounter in a clinical setting. Each patient simulation "consists of short videotaped scenes of patients experiencing one or more problems about which the nurse must make a clinical judgment" (Tanner et al., 1982, 5). The patient simulation also includes patient information available to the nurse subject, on request, after viewing the videotaped simulation. This includes such information as physical assessment data and patient history information (both information obtained on admission and current information); laboratory results; medication information (e.g. drug, dosage, time given); and vital sign information.

simulated nursing report: Basic orienting data about the patient simulation presented verbally to each nurse subject prior to viewing each patient simulation described above. This data is the type that would be given to a nurse in a clinical setting prior to his/her contact with a patient. Such information is usually given at a "change of shift" report and includes such information as the patient's age, sex,

medical diagnosis, length of treatment, number of post-operative days (Tanner et al., 1982, in progress).

cue: "a unit of information about a patient, including physical signs and symptoms, lab data, medical diagnosis, social history, factors in cultural background and physical or psychological factors in the environment" (Tanner, 1977, 93). A cue is judged by a panel of experts to be present in the patient simulation.

diagnostic process: "The act of diagnosing is the process of inferring from a series of observable cues an internal, unobservable state of the patient." (Tanner and Hughes, 1984, 31).

nursing diagnosis: a description of "health problems in which the responsibility for therapeutic decisions can be assumed by a professional nurse...such problems encompass potential or actual disturbances in life processes, patterns, functions or development including those secondary to disease" (Gordon, 1976, 1298). For example, "diabetes mellitus" is a medical diagnosis, while the nursing diagnosis related to this may be "knowledge deficit related to the management of diabetes mellitus; or role alteration related to being a newly diagnosed diabetic."

B. Assumption

"Nursing has a domain for diagnosis and management that is distinct from other health-care disciplines" (Carnevali, 1983, 9). This implies that nurses can make diagnoses which are distinct from medical diagnoses. Thus knowledge of the medical diagnosis (as well as other data e.g. laboratory results; signs and symptoms) will assist the nurse

in his/her information gathering activities to formulate a nursing diagnosis.

C. Research Design

This descriptive study is, in part, a replication of a study currently in progress at Oregon Health Sciences University, School of Nursing (Tanner et al., 1982). The methodology employed is based on the observation that "well defined sets of cognitive operators underlie the observed problem-solving behaviors of the expert and that these operations can be discovered by analysis of expert use of information in a problem environment and by expert reports of problem-solving behavior. The net result is a clarified understanding of the structure of the problem environment as seen by experts, as well as general rules and strategies proven to be effective for problem solving" (Newell & Simon, in Broderick and Ammentorp, 1979, 106).

The strategy used to examine problem-solving behavior from an information processing theory perspective is the use of patient simulations and subsequent verbal protocol analysis of experts' verbalizations as they analyze the patient simulation (Tanner, 1983; Elstein et al., 1978). That was the methodology employed for the current study. Use of a simulation allows an investigator to achieve some degree of control over the experimental situation and is more practicable then using the actual clinical environment where finding several nurse-patient situations which are alike would be difficult (Elstein et al., 1978). With respect to the patient simulations, the goal of any investigator is to develop simulations that attain a high

degree of fidelity (representativeness) to the actual clinical situation.

Types of patient simulations used in diagnostic reasoning research have included individuals simulating patients (Elstein et al., 1978; Kassirer & Gorry, 1978); written case studies or patient management problems (Dincher & Stidger, 1976; McIntyre et al., 1976; Williamson, 1965); and videotaped vignettes "portraying the initial part of the clinician-patient encounter" (Tanner, 1983, 13).

In research paradigms employing a trained actor to simulate a patient, the clinician subject is asked to proceed in his/her diagnostic workup as he usually would in order to identify the patient's problems. In paradigms employing written or videotaped case studies, the clinician subject is asked to seek information from the examiner as if he/she were eliciting that information from the patient. Both concurrent and retrospective verbal protocols are utilized. That is, the clinician subject is asked to "think aloud" during the diagnostic workup (concurrent protocol) or the subject is asked to recall what he/she was thinking on viewing a videotape or listening to an audiotape of the workup (retrospective protocol). With both types of protocols, the clinician subject's verbalized thoughts are audio-recorded and subsequently transcribed. Content and quantitative analysis are then performed on the resultant transcripts (Tanner, 1983; Elstein et al., 1978).

The basic assumption underlying the use of verbal reports as data is that verbal behavior is seen as "one type of recordable behavior, which should be observed and analysed like any other behavior. The cognitive

processes that generate verbalizations are a subset of the cognitive processes that generate any kind of recordable response or behavior." (Ericsson and Simon, 1984, 9). This aspect of information processing research is not without criticism. Neisser (1968, in Elstein et al., 1978, 15) argued that the very act of verbalization alters the content and process of thought. Nisbett & Wilson (1977), on reviewing verbal data generated from many psychological experiments, noted that when people are asked to report on how a particular stimulus influenced a particular response, the respondents tend to generate responses that are socially desirable rather than "consulting a memory of the mediating process" (p.248). This together with other related literature was taken as evidence by Nisbett & Wilson that people often "tell more than they know" (1977, 247). It should be noted, however, that many of the experiments reviewed by Nisbett & Wilson had a large component of social desirability to them. That is, subjects were confronted with their mistakes and inappropriate behavior and perhaps to "save face" or decrease cognitive dissonance these subjects verbalized inaccurately.

Nisbett & Wilson (1977) suggest that one way in which errors in verbal reports can be reduced is to minimize the time between the actual occurrence of the diagnostic process and the verbal report. Further, Ericsson & Simon (1980) presented information that suggests that producing verbal reports of information that are directly accessible in memory does not change the nature of the cognitive process. However, if the subject is instructed to recode the information in some way it may change the cognitive processes. Thus the prompting cues used to elicit cognitive processes are very important to the quality of the data which

results from such introspection. Despite the criticisms of Nisbett & Wilson there seems to be no alternate method, at present, of identifying the activities cognitive that clinicians use to solve problems than to have the subjects think aloud as they solve clinical problems.

D. Sample

One of the constraints with using the information processing research paradigm with verbal protocol analysis is the volume of of data it produces (Tanner, 1983; Elstein et al., 1978; Kassirer and Gorry, 1978). Consequently research studies employing this methodology generally utilize a small number of subjects. As further noted by Feltovich (1981) sample size is limited with this type of research because of the time it takes to prepare material, the time commitments required of subjects to carry out the tasks (in the current study approximately 2-4 hours) and the method of data analysis used (content analysis).

A review of studies using introspection and verbal protocol analysis suggests sample sizes have ranged from 6 to 24 subjects. Kassirer and Gorry (1978) studied six clinicians, while Allal (1973, in Elstein et al., 1978) utilized 8 subjects in her research. Corcoran (1984) employed 10 subjects in total (5 "experts" and 5 "novices") when she investigated the decision making processes used by hospice nurses when developing drug administration plans to control pain. Feltovich (1981) utilized a total of 12 subjects with 4 subjects in each of 3 groups (students, trainees and expert) in his study of the contribution of case-related medical knowledge to clinical diagnoses. Elstein and

associates (1978) studied the diagnostic reasoning behavior of 24 physicians in their study of medical diagnostic reasoning. Finally, Tanner and associates (1982, in progress) studied 43 nurses in their study which was described in the literature review.

Given the constraints of time and amount of data generated with the introspective research technique and verbal protocol analysis, and in light of the sample sizes used in the previous research studies noted above, the sample for the present study consisted of ten registered nurses.

Permission to conduct the study was obtained from the University of Alberta Hospitals Nursing Research Committee in June of 1984. The specific nature of the study, its purpose and methodology were discussed with the nursing staff involved. Unit supervisors of all general medical and surgical units of the University of Alberta Hospitals were asked to nominate (a) registered nurse(s) who met the following criteria. The nominated subjects(s):

1. must have at least two years clinical experience on a general medical or surgical nursing unit.

2. must possess a baccalaureate degree in nursing.

3. must be perceived by the unit supervisor to be an expert clinician. To facilitate the selection of an expert clinician the unit supervisor chose a nurse who, in addition to numbers 1 and 2 above, met at least three of the following criteria:

i) is skilled in recognizing and discriminating among external signs in patients (Benner and Wrubel, 1982).

ii) analyzes clinical problems and takes appropriate actions

(Benner and Wrubel, 1982).

iii) consistently makes good clinical judgments.

iv) keeps current in nursing by attending relevant workshops and/or reviewing journals and other related material.

v) takes actions directed toward meeting the psychosocial needs of patients e.g. is a receptive listener, approaches patients in a kind and gentle manner, creates an atmosphere of trust and acceptance (Wandelt and Stewart, 1975).

vi) takes actions directed towards meeting the physical needs of the patient e.g. identifies physical symptoms and changes; recognizes hazards to patient safety; carries out nursing procedures, including medication administration, safely (Wandelt & Stewart, 1975).

vii) communicates clearly in all aspects of patient care e.g. verbal reports, nurses' notes, nursing care plans, interdisciplinary communication.

viii) is reliable, a good leader and self-directed (Wandelt and Stewart, 1975).

Fifteen possible subjects were obtained from the general medical/surgical, isolation, urology and burns/plastics units of the University of Alberta Hospitals. After discussion with the nursing area supervisors of the medical and surgical units, it was decided to retain the nominated subjects from both the urology unit (they often had general surgery cases) and the isolation unit (they cared for both medical and surgical patients). The three subjects nominated from the burns/plastics unit were not included in the list of possible subjects as that area was thought to be too specialized to be considered a

general medical and surgical unit. This left twelve possible subjects who met the criteria described above.

The names of the candidates were listed in random order using random selection. Each potential subject was contacted by telephone in the order she appeared on the list compiled from the random selection. All potential subjects were informed about the nature of the study, its purpose and methodology. In addition, all potential subjects were assured that the data and results would be kept private and confidential and would in no way be used in any way to cause them harm or to evaluate their current clinical performance. A total of ten subjects agreed to participate in the study. Two subjects (one from a general surgical unit and one from the isolation unit) refused to participate as they were moving from the city before data collection could begin. They both indicated that had they been staying in Edmonton, they would have participated in the study. Each selected subject was assigned a code number so that anonymity of the subjects could be assured. Agreement to participate in the study and an informed consent was obtained from each subject and was evidenced by each subject signing a consent form (see Appendix A).

Demographic data was collected from each subject who agreed to participate in the study (see Appendix B) and included the following information: age of subject; years of clinical experience; type of baccalaureate degree (basic or post-basic); if a post-basic baccalaureate degree, type of diploma program; country where basic nursing education obtained; type of unit where currently employed; other specialized courses taken (e.g. I.C.U. course), and sex. The subjects are described below:

Age

All ten subjects were female. Their mean age was 29 years with the range being 21 to 50 years.

Education

Eight subjects had basic baccalaureate degrees, including one subject whose basic degree was obtained in India. All other subjects with basic baccalaureate degrees earned their degrees in Canada. Two subjects had post-R.N. baccalaureate degrees. Their basic nursing education was obtained in three year hospital school progams in the Phillipines and Malayasia.

Clinical Experience

The average number of years of clinical experience for nine subjects was 5.7 years, while one subject had more than 12 years experience. Those two subjects with post-R.N. Baccalaureate degrees each had more than 10 years of clinical experience following completion of their baccalaureate degrees. Three of the subjects were employed on general medical units, five subjects were employed on surgical units and two subjects were employed in the isolation unit.

Additional Education

With respect to other educational courses taken apart from basic nursing education, two subjects had completed a physical assessment course and two subjects had completed a burn course offered by the Inservice Education department of the hospital. One subject completed an I.C.U. course, also offered by the Inservice Education department of the hospital, and one subject had both a midwifery and a public health nursing certificate.

E. Test Procedure

A nursing report and videotaped simulation were used with all subjects as "stimulus materials to elicit diagnostic reasoning processes by the subjects. Subjects [were] asked to seek information from the examiner as they would in the actual patient situation and to think aloud, describing their 'reasoning' as they [sought] this information" (Tanner et al., 1982, 6). Additional data (e.g. physical exam data, lab results, nursing/social history, reference material) were available if the subject requested it.

It is recognized that experimenter bias may influence results with this type of experimental procedure. As noted by Christensen (1980, 112), "experimenters can communicate their expectancy (with respect to anticipated results) by means of a nod, a glance or a smile." A nod or smile by the data collector (the writer) in the current study might have communicated to the subject that she/he is identifying the correct diagnosis, while a frown or shake of the head by the data collector might have conveyed the opposite meaning. Therefore, the data collector must guard against the use of gestures or expressions which may communicate desired subject behavior. To minimize the risk of this occurring, the data collector sat beside every subject while the subject viewed the videotaped simulation and completed the diagnostic workup.

A pilot study, with a sample of two baccalaureate prepared nurses both with more than 4 years clinical experience and with advanced nursing preparation (both M.N.candidates), was conducted for several purposes:

1. To familiarize the data collector (the writer) with the data

collection procedure.

2. To determine if the instruments had applicability for the Canadian nurse scene.

3. To determine if the data collection procedure was feasible with respect to subject fatigue, level of difficulty, and time required to complete the procedure.

4. To test the coding strategies with respect to content analysis of the transcribed protocols.

Each pilot subject was tested individually. Data were collected in June 1984. With the first pilot subject data were collected during two separate 1 1/2 hour test sessions with one day intervening between each session. Three videotaped simulations (see Appendix C) with accompanying nursing reports were used to train the subject in the thinking aloud procedure, while the fourth simulation (see Appendix D) was used for actual test purposes. Simulations #5 and #6 were completed on the first day of data collection, while simulation #8 and #10 were completed on the second day of data collection. The information gathering and "thinking aloud" for each simulation was tape recorded and transcribed for subsequent data analysis. The audiotape for each training simulation was played back to each pilot subject prior to completing the diagnostic workup for simulation #10. The written examination was administered to each pilot subject after the completion of the simulation exercises. General results of the data collection procedure with the first pilot subject follow.

The subject reported that collecting the data over a 3 day time period prolonged the procedure unnecessarily. In addition, she noted it

was not helpful to her to replay the audiotape at the conclusion of each training simulation. However, she reported, it was helpful to review in general terms, information and plausible diagnoses at the conclusion of each diagnostic workup. This subject did not find the data collection stressful and did not appear to have major difficulties with the thinking aloud task. She noted that the examiner did not cue her to appropriate responses by use of facial expressions/gestures. The subject was allowed to take notes during the data collection procedure except when viewing the videotape. In addition, on request, the subject reviewed any reported laboratory values by examining the information from the followup material (see Appendix D).

Based on the results of data collection with the first pilot subject, modifications were made to the data collection procedure with the second pilot subject. Data were collected during a three hour period at one sitting. The same videotaped simulations were used for training the subject in the thinking aloud procedure. Again each diagnostic workup was audiotaped and played back to the second pilot subject at the conclusion of each workup. The remainder of the test procedure was the same as for the first pilot subject.

The second pilot subject did not find the test procedure stressful or fatiguing. She, too, reported it was not helpful to play back the audiotape at the conclusion of each workup, although it was helpful to have a general discussion about each workup at its conclusion. Pilot subject #2 also reported that the examiner did not cue her, by use of facial expressions, during the test procedure. Neither pilot subjected reported the stimulus materials were difficult to understand.

Transcribed protocols from both pilot subjects were used to train the coders prior to data analysis (see chapter five). Data obtained from the pilot subjects was not included in the data pool for actual data analysis in the current study.

Based on the results of the pilot study, the following procedure was implemented for data collection. Each subject was contacted by telephone and a date was set for data collection. Data were collected from July 25, 1984 to September 25, 1984. Each subject was tested individually during a 2 to 3-1/2 hour time period. A room free of distractions was equipped with a 3/4" video-playback unit, an audiocassette tape recorder and a table with 2 chairs. Prior to any data being collected the procedure was explained to each subject and time was allowed for any questions. Each subject was instructed that the overall task was to identify the patient problems and appropriate nursing interventions associated with each simulated nursing report and videotaped simulation. When the subject felt she understood the task, she signed a consent form (see Appendix A) indicating she agreed to participate in the study.

Three simulations (#5, #6 and #8) were used to train the subjects in the thinking aloud procedure while simulation #10 was used for actual data collection. (see Appendices C and D).

For each simulation, the examiner, who sat beside the subject, began by reading the nursing report that accompanied each simulation. The subject was allowed to take notes during this portion of the procedure. After the report was read, each subject was asked to respond to the question "What are your thoughts now that you've heard the nursing

report?" Subjects were then asked to seek the kind of information from the examiner that they would in actual clinical practice (e.g. lab data, physical exam data). The examiner responded to any request for information by using the prepared case material (see example Appendix D). Prior to providing the requested information the subject was asked how that information would help the subject. After the requested information was provided, the subject was asked how the information helped the subject (see Appendix E). Once the subject felt she had enough information to proceed with the task, she asked to see the videotape simulation.

After viewing the videotape, the subject was again asked to respond to the question "What are your thoughts now that you've seen the videotape?" Again the subjects were instructed to ask for additional information. The same prompting questions were used as those that followed the nursing report. When the subject felt she had completed the diagnostic workup, she was asked to summarize her conclusions about what was wrong with the patient and to offer nursing actions appropriate for each identified problem. All subjects were allowed to take as much time as they required to complete the diagnostic workup.

All thinking aloud protocols were tape recorded and transcribed. The training tapes were not played back to each subject, but time was allowed for any discussion at the conclusion of each training simulation. If requested, each subject was allowed a break before completing simulation #10. After the subject had completed the diagnostic workup for simulation #10, and had therefore identified the final patient problems, she was asked to review the cues utilized to

identify each of the problems. Once that task was complete, each subject completed the written examination and the data collection procedure was terminated.

F. Instruments

Two measures were used in this study. The first was a written examination of knowledge of the content related to the nurse-patient simulation used. The second was the videotaped simulation and simulated nursing report which formed the stimulus materials to elicit the diagnostic reasoning processes of the nurse subjects.

1) Written Examination

The written examination (see Appendix F) consisted of 41 multiple choice, matching and true/false questions taken from the original written examination developed by Tanner and associates (1982, in progress). The original 128 item examination was designed to assess knowledge of the content related to the nine videotaped simulations used in Tanner and associates' study (1982, ongoing) and was made up of 9 subscales, of 10-20 items each, related to each of the simulations. Content validity was presumed through the use of a table of specifications and through construction and review of all examination items by members of Tanner's research team (personal communication, Dr. C. Tanner, April 9, 1984). Internal consistency reliability of the original 128 item examination was computed to be 0.68 (KR-20). Changes were made to some of the items on the original examination based on the results of the internal consistency measures for the total examination.

The written examination used for the present study consisted of

forty-one items taken from the original examination. Twenty-eight of those items related specifically to the content knowledge of the videotaped simulation to be used for test purposes in this study (items 1, 13-29, 31-32, and 34-41). It was discovered after data collection had begun that one of the items on the subscale relating to simulation #10 had been inadvertently omitted when the written exam was forwarded by Tanner and associates to the writer. Therefore, the subjects in the current study completed a 28 item written examination related to simulation #10, not a 29 item examination. The internal consistency reliability measurement of the original 29 item examination was 0.79 (alpha).

The specific content areas tested in the 28 item examination were nursing knowledge of sensory changes (e.g. pain, sensory deprivation), immobility, electrolyte imbalance, aging, confusion (including organic brain syndrome), cirrhosis and diabetes, all of which are related to the videotaped simulation. Knowledge of the content area of the clinical simulation is an important contributing factor to the diagnostic reasoning performance related to that simulation (Holzemer et al., 1981). The results of the examination were used by Tanner and associates (1982) to assess the relationship of content knowledge to diagnostic reasoning strategies. Raw scores, that is, total number of correct items out of 28 items, were tabulated for the current study.

Content validity of the written examination was reassessed with the writer and the principal investigator from the Tanner research group reviewing the examination against the table of specifications (see Appendix G). On review of the table of specifications, it was noted

there were 40 items from the original test pool that could have been used to assess knowledge of content related to simulation #10. When the subscale related to simulation #10 was developed, 29 items (28 items for the current study) were selected from the 40 item pool. Inadvertently too many items related to diabetes/insulin (items 29, 31, 32, 34 and 35-40) and electrolyte imbalance (items 15 to 20) were included in the exam. Therefore, those particular topics were over-represented.

If those over-represented items measured the same concept, inter-item correlations should be high. A review of the inter-item correlations from Tanner's study (N=42 subjects), indicates there were 8 of 15 inter-item correlations relating to electrolyte imbalance that were > 0.300, and 4 of 21 inter-item correlations relating to diabetes/insulin that were > 0.300. This suggests the items relating to electrolyte imbalance tended to measure the same concept while those related to diabetes/insulin tended to measure different components of diabetes/insulin knowledge.

Tanner (personal communication, December 7, 1984) speculated the over-representation of items may have accounted for the low correlations found in their study between number of hypotheses considered and written exam results (r=0.213); between accuracy of diagnoses and written exam results (r=0.029); and between inaccurate diagnoses and written exam results (r=0.288). However, it may be as McGuire, Solomon, and Bashook (1976) suggested, that low correlations between scores in written simulations (and presumably this would apply to videotaped simulations) and traditional objective tests, are low because skills sampled by use

of simulations differ from those assessed by more conventional techniques.

On further review of the table of specifications, it was noted there was only one item related to signs and symptoms of cimetidine (item #117 of the original examination) which was not included in either the 28 or 29 item subscale related to simulation #10. Assessment of knowledge of side effects of cimetidine is important as that was one of the accurate diagnoses subjects could make after the completion of the diagnostic workup. All other topics noted on the table of specifications and related to simulation #10 were included on the written examination.

Internal consistency reliability of the written examination for the 10 subjects used in the current study was computed to be 0.75 (alpha). It should be noted this was computed for 26 items only, as 2 items (items 4 and 32) had zero variance as they were answered correctly by all subjects. In an attempt to improve the content validity of the written examination the number of items related to electrolyte imbalance and diabetes/insulin were reduced by randomly selecting one-half of the available items for each topic (6 available items for electrolyte imbalance and 10 available items for diabetes/insulin). The resulting written examination consisted of 20 items, with items 15, 16 and 17 retained for electrolyte imbalance and items 29, 31, 35, 37 and 38 retained for diabetes/insulin. It was recognized that decreasing the number of items in the examination would necessarily decrease the alpha coefficient, but it was felt it was preferable to attempt to improve the content validity of the examination at the expense of the internal consistency measure. If the examination is testing knowledge of

different concepts, it may be expected that a lower internal consistency measure may result. The internal consistency measure of the 20 item written examination with the subjects in the current study (N=10), was 0.58 (alpha). The effect of the reduction of the number of items on the written exmaination results are discussed further in chapter five.

Given the concerns identified above with respect to the content validity and the reliability of the written examination, results of the examination should be viewed with caution when correlated with results from the simulated diagnostic workup.

2) Simulation Materials

The most commonly used method of evaluation of clinical prob-lem solving is the written patient management problem (PMP) (Tanner, 1977). Originally developed by Rimoldi (1955) and refined by McGuire and Babbott (1967) the PMP has been used extensively in medicine (Page and Fielding, 1980; Goran, Williamson, Gonnella, 1973; Sedlacek and Nattress, 1972) to assess clinical problem solving, and more recently in nursing (Farrand et al., 1982; McLaughlin, Cara and Deluchhi, 1981; Holzmer et al., 1981; Dincher and Stidger, 1976; and de Tournyay, 1968) for the same purpose. The PMP generally begins with a description of the particular patient problem to be solved which is followed by a series of multiple choice questions about the first step in patient management. The examinee selects a response (usually by erasing an opaque overlay on a specially constructed answer sheet) after which information is provided about the consequences of the selected choice and another series of questions is presented. This sequence is repeated until the clinical problem is resolved (Sedlacek and Nattress, 1972).

Although the PMP is easy to administer and can be objectively scored, it does have some disadvantages (Vu, 1979; Tanner, 1977). The examinee is cued to signs and symptoms of which she/he may not have been aware in an actual patient encounter, because they are provided in the list of alternative responses. In addition, the PMP "does not provide access to a number of important (cognitive) components of (clinical reasoning) including early hypotheses and the utilization of cues provided in confirming or ruling out hypotheses" (Tanner, 1977, 119).

To attempt to compensate for these identified disadvantages, Tanner (1977), in her initial study of diagnostic reasoning, developed videotaped simulations to serve as the stimulus materials to elicit diagnostic reasoning strategies of nurse subjects. Videotaped simulations were also used as the stimulus material in Tanner and associates' current study (1982, in progress) which is being replicated, in part, in this present study. The use of videotaped simulations to analyze diagnostic reasoning strategies has the advantage of not cuing the subject to the possible diagnoses by providing a list of responses from which she/he may choose. A discussion of the development and preparation of the simulations used for the present study follows.

Development of simulation materials

The eleven simulations (9 for test purposes and 2 for training the subjects) were developed by Tanner and associates after interviewing forty nurses from the Portland, Oregon area. These nurses were asked 1) to identify situations where nursing decisions had made a difference in patient care and 2) to describe a common-place patient care situation

in which such a decision had taken place.[6] Twenty-five different nursing situations/medical diagnoses emerged after an analysis of the situations described by the nurses. Clinical records of patients with these kinds of medical diagnoses/nursing diagnoses were reviewed by Tanner and associates in medical and surgical units of acute care hospitals and in the Visiting Nurse Association caseload of Portland health care facilities. The records were examined for cues associated with the nursing diagnoses and management, and for actual patient data (e.g. lab test results, vital signs, etc.). Thus the simulations were based on actual clinical cases, a practice which Rimoldi (1961a) demonstrated is preferable (i.e. gave better results in determining how a medical student proceeds when diagnosing a clinical case) to developing specially prepared simulations not based on actual clinical cases.

After reviewing the clinical records, 11 actual clinical situations were distilled which formed the basis for the development of the videotaped simulations and accompanying data (simulated nursing report, history information, lab test, medication records, vital sign sheets) in Tanner and associates' currentstudy. "The cases used for the simulations are representative of both diagnostic content typically encountered in hospitalized patients and the kinds of strategies needed to derive the most probable diagnosis.

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[6]This information was obtained from personal communication with Dr. Tanner, April 9, 1984.

Included among the eleven simulations are diagnostic tasks in which: 1) initial cues suggest many diagnostic hypotheses; 2) derivation of an accurate diagnosis requires a thorough information search; 3) a set toward one diagnosis is imposed by initial cues; 4) attention to subtle cues in necessary for accurate diagnosis; and 5) several diagnoses remain plausible even after a thorough information search" (Tanner et al., 1982, 5-6).

The simulation used in the current study (Simulation #10) is an example of a simulation whereby an accurate diagnosis requires a thorough information search (#2 above) and several diagnoses remain plausible even after a thorough information search (#5 above). Each presentation developed for videotape included a chief complaint and portrayal of cues suggesting a problem for which nurses could intervene. The videotape simulation is preceded by a simulated nursing report which presents basic orienting data e.g. the patient's age, sex, length of hospital stay, medical diagnosis, number of days post-operative and so forth.

Four of the eleven simulations developed by Tanner and associates were employed in the present study. Three of the simulations (see Appendix C for a brief description of the training simulations) were used for training the subjects to think aloud, while simulation #10 was used for actual test purposes.

Simulation #10 depicts a 70 year old gentleman with a history of abdominal pain, adult onset diabetes and alcoholism. He is observed on the videotape to be seemingly disoriented and confused. See Appendix H for a list of the relevant cues available to the nurse subject from the

videotape and the nursing report. Appendix H also lists the accurate hypotheses and the diagnostic hypotheses which will be described in the data analysis section (Chapter five). The simulated nursing report and a list of the information (general health history, lab data, insulin flow sheet, medication record, graphics sheet) available to the nurse subject if she requested it during the "thinking aloud" procedure are presented in Appendix D.

Reliability of the videotaped simulation: Traditional methods of calculating reliability are difficult to apply to written simulations (McLaughlin et al., 1981; Vu, 1979; Dincher and Stidger, 1976) and are consequently even more difficult to apply to videotaped simulations. Because cues in a written or videotaped simulation are not independent of each other, conventional methods to determine internal consistency reliability are not appropriate (Vu, 1979; de Tornyay, 1968). Split-half correlations cannot be computed as there are different reasoning approaches which can be used to arrive at the final diagnoses (Dincher and Stidger, 1976). Test-retest measures of reliability are not appropriate because knowledge of the cues, diagnoses and so forth obtained during the first assessment of reliability will confound with the second estimate of reliability (Bashook, 1976).

In an effort to overcome these difficulties Speedie (1976 in Vu, 1979, 303) "has suggested that reliability should be redefined and measured according to the general purposes of the investigation. For example, if the investigator is interested in determining general human problem solving characteristics, it is important to control the experimental conditions to improve the accuracy of the measurement."

Thus the use of the same videotaped simulation as the stimulus material for all subjects assures more control over the experimental condition than the actual clinical situation would.

Interrater agreement as measured by percent agreement among three raters of the relevant cues present in the videotape and the nursing report was calculated (see Appendix H). Two of the raters were medical-surgical nursing instructors from the University of Alberta Faculty of Nursing, both with master's degrees in nursing. The third rater was a medical-surgical clinical nurse who is currently enrolled in a master's of nursing program. The average number of years of clinical and teaching experience of all raters was 22 years. The raters independently viewed the test videotaped simulation and read the simulated nursing report and listed all the cues observed/heard. In addition, the raters completed a short questionnaire related to the appropriateness of the simulated nursing report and videotaped simulation (see Appendix I). The list of cues obtained from the raters was compared to the list of cues used in the development of the videotapes, and a percent agreement score was calculated. For example, there were 12 relevant cues in the simulated nursing report for a total of 36 possible relevant cues to be noted by the 3 raters. If the three raters each noted 10 relevant cues that would comprise an 83% agreement (30/36) between the number of cues the raters noted and the total number of relevant cues possible.

There were 12 relevant cues in the simulated nursing report as developed by Tanner and associates (1982). Eleven of the 12 relevant cues were noted by each of the three raters, while one cue ("admitted

three days ago") was noted by one rater, for a 94% agreement. The questionnaire relating to the nursing report rated the four items measured along a 7 point Likert-type scale, with a "1" indicating maximum amount of the dimension measured, and a "7" indicating minimum amount of the dimension measured. The results of the questionnaire indicated the raters felt the nursing report: 1) used terminology that was understandable ($\bar{X}$=1.33); 2) was typical of the kind of report nurses would receive at change-of-shift ($\bar{X}$=2.0); 3) contained enough information to begin a patient assessment ($\bar{X}$=2.7); and 4) was relevant to a clinical nurse on a general medical-surgical nursing unit ($\bar{X}$=2.5). Interestingly, all three raters wanted more information after reading the nursing report, indicating the nursing report was effective as a stimulus tool to initiate the diagnostic reasoning task.

With respect to the videotaped simulation there were 8 relevant cues as developed by Tanner and associates (1982) (see Appendix H). Five cues were noted by all three raters while one cue (hearing aid on stand) was noted by two of the three raters. Two cues ("T.V. going" and "night") were not noted by any rater. The percent agreement between total number of cues noted by the raters and total number of cues possible (24) was 71%. A five item questionnaire similar to the one described above was completed by the raters. The results of the questionnaire indicated that the raters felt the videotaped simulation: 1) depicted a situation a clinical nurse is likely to encounter on a medical-surgical unit ($\bar{X}$=1.0); 2) was realistic ($\bar{X}$=2.0); 3) depicted cues typically seen in a 70 year old man with apparent confusion ($\bar{X}$=2.0); 4) held the raters' attention ($\bar{X}$=1.0); and 5) depicted cues

typical of information nurses usually have for selecting information ($\bar{X}$=1.33). One rater could not clearly distinguish the hearing aids on the table, which may be important in that some subjects, during data collection, did not note the hearing aids (see chapter six for elaboration of this point).

One rater had some additional comments about the videotaped simulation. She felt the appearance of the man in the video did not fit a 70 year old male with the numerous problems noted in the nursing report. As well, from this rater's experience, the patient's clear articulation and normal respiratory rate was incongruent with the typical picture of a man with viral pneumonia and ineffective cough. Finally this rater felt that a man who was confused would move more than his head during his apparent confusion.

Despite the criticism noted above, the simulated nursing report and videotaped simulation led to a high degree of inter-rater agreement with respect to the cues included in preparation of the materials. As well, the raters were in general agreement that the materials were typical, understandable and contained sufficient information to begin an initial patient assessment or diagnostic workup.

As another measure of reliability, each research subject (N=10) was asked to verbally identify the cues used to arrive at the patient problems identified at the conclusion of the diagnostic workup. This verbal discussion was tape recorded and transcribed. All subjects, except one, identified confusion/disorientation as a patient problem.

The writer reviewed the transcriptions and identified the cues noted by all subjects related to the problem "confusion". The following cues

related to confusion were identified by 5 or more subjects:

1) the patient was "off in another world", "talking irrationally" (N=9);

2) the patient was disoriented to person, place and time (N=6);

3) the nurse was unable to re-orient the patient (N=5).

Three subjects noted "the hearing aids on the table" as being important to the problem of confusion, while two subjects felt the "glasses on the table" was important to the identified problem: confusion.

Although the identified problem "confusion" was less specific than the three accurate diagnoses possible after the diagnostic workup, the majority of subjects did note all the cues related to patient confusion ("patient rambling", "calling nurse Elsie", "doesn't respond to attempts to reorient") which again establishes a measure of inter-rater agreement against the relevant cues in the videotape.

Validity of the videotaped simulation: Content validity of the videotaped simulation was examined by comparing the cues present in the videotaped simulation (see Appendix H) with authoritative literature against the three accurate diagnoses noted in Appendix H: sensory deprivation related to physical impairment, Sundowner's Syndrome (confusion), and side effect of cimetidine. This proved to be a difficult task as those diagnoses have not been well defined in nursing. As noted by Norris (1982) an operational definition of a concept is required so that an individual will know when s/he is exposed to that concept. "Imprecision in the use of terms, lack of clarification of nursing phenomena and lack of discriminatory skills make operational definitions [in nursing] difficult" (Norris, 1982,

16). A review of five current medical-surgical text books revealed no mention of sensory deprivation, confusion and/or disorientation.

A review of the Manual of Nursing Diagnoses (Gordon, 1982) revealed two diagnostic categories pertinent to the current study: cognitive impairment, potential and sensory deprivation. Diagnostic categories contained in that manual are based on the work of the National Group for the Classification of Nursing Diagnoses as described in the literature review. A list of the defining characteristics (cues) determined by the Classification group to be critical to the diagnoses sensory deprivation and cognitive impairment, potential is found in Table 1. A comparison of those cues with the cues in the simulated materials, suggests a high degree of congruence between the cues. Thus, there appears to be justification to say that the videotape simulation (and follow up information) contained sufficient information for the subject to identify the diagnoses sensory deprivation and cognitive impairment (Sundowner's syndrome).

TABLE 1

DEFINING CHARACTERISTICS (CUES) OF NURSING DIAGNOSES[a]:

COGNITIVE IMPAIRMENT, POTENTIAL AND SENSORY-PERCEPTUAL

ALTERATION: SENSORY DEPRIVATION

CUES: COGNITIVE IMPAIRMENT, POTENTIAL	CUES: SENSORY-PERCEPTUAL ALTERATION: SENSORY DEPRIVATION
1. low self-initiative in providing cognitive stimulation*	1. alert with periodic disorientation, general confusion, or nocturnal confusion*
2. confinement to environment low in cognitive stimulation*	2. hallucinations*
3. hearing and/or vision deficit*	3. apathy
4. borderline neurophysiological pathology	4. auditory, visual, reality orienting or time orienting input reduced or absent*
5. receiving tranquilizers, sedatives	5. limited proprioceptive input*
	6. presence of uncomplicated visual or hearing deficits*

[a]From Gordon, M. Manual of nursing diagnosis. Toronto: McGraw Hillbook Co., 1982, 130, 140

*indicates a cue present in simulated materials (simulation #10)

Moreover, it was noted in one medical-surgical text book (Armstrong et al., 1979) that ability to metabolize medications decreases with age; therefore the elderly have less tolerance to medications. In addition, the Compendium of Pharmaceuticals and Specialities (1984) indicates a possible side effect of cimetidine is confusion in the elderly. The

visual cue (in the videotape) that the patient was receiving an intravenous medication and the follow up information that the intravenous medication was cimetidine was also sufficient information for a subject to identify the diagnosis "confusion, related to side effect of cimetidine".

As the simulated patient (see Appendix D) exhibited signs of confusion/disorientation, a review of the literature with respect to disorientation was conducted. Castleberry and Seither (in Norris, 1982) reviewed the concept disorientation and noted there has been little effort to define that concept in nursing. They further commented that confusion and disorientation are often used synonymously, although little research exists to establish whether they are in fact synonymous terms. The authors identified a number of factors that may predispose to and/or be associated with disorientation (see Table 2). Again a comparison of those factors against the cues for simulation #10 suggest that sufficient cues were present in the simulated materials to identify the diagnoses sensory deprivation, disorientation (Sundowner's) and side effect of cimetidine, if the subject pursued a thorough information research.

TABLE 2

PREDISPOSING FACTORS ASSOCIATED

WITH THE CONCEPT OF DISORIENTATION[a]

1. Side effect medications*	6. sleep deprivation
2. metabolic conditions e.g. hypo/ hyperglycemic*	7. disoriented at night, especially in the elderly*
3. poor nutrition	8. insufficient supply and/or utilization of oxygen
4. severe electolyte imbalance	9. loss of familiar environment*
5. sesnsory deprivation*, overload or altered sensory acuity	10. infection in the elderly

[a]From Castleberry, K. and Seither, F. In Norris, C. (Ed.). Concept clarification in nursing. Rockville, Maryland: Aspen Corporation, 1982, 313-316.

*indicates cue present in simulation #10

An additional attempt was made to establish content validity of the simulated materials related to simulation #10. A list of 40 cues, taken from the nursing report, videotaped simulation and follow up information, was presented to three raters, independently. The raters were asked to rate each cue on a 7 point Likert-type scale (1=not very important/relevant; 7=very important/relevant) with respect to that cue's relevance and importance to the three acurate diagnoses (see Appendix J). Relevance was defined as information that is important to the stated diagnosis because it either rules in or rules out that diagnosis. Importance was defined as those critical characteristics or pieces of information that must be present in order for the rater to say the patient has the stated diagnosis.

The cues in Appendix J included those cues determined by Tanner and associates to be relevant to the accurate diagnoses as well as those cues which were not felt to be important/relevant to the accurate diagnoses. If the cues determined by Tanner and associates to be relevant to the accurate diagnoses were in fact relevant and/or important, those cues should be rated very high on the relevance or importance scale by the panel of raters.

The three raters included two nurse educators with doctorates in nursing and one clinical nurse pursuing an M.N. degree. All raters had at least 10 years experience as clinical nurses/educators. In order that the raters would judge the cues independently of the simulation and therefore not be biased by the information presented in the simulated materials, all raters were given a general description of the research task, but they did not have access to the simulated materials.

A mean rating of each cue was calculated for all three diagnoses along the dimensions of relevance and importance. Those cues which received a mean rating of greater than 5 on either the relevance or importance dimension were considered to be important and/or relevant to the identified diagnoses (see Appendix K).

As can be seen by examining Appendix K there were more cues noted for the relevance dimension than for the importance dimension. This is to be expected because there are more pieces of information that need to be considered to rule in and/or to rule out a diagnosis. Of the eight cues in the videotape considered by Tanner and associates to be relevant to the three diagnoses, all 8 were noted by the three raters in a least one of the diagnoses. Two cues ("patient talking aloud to himself" and

"patient does not respond to nurses's attempt to orient") were noted by all 3 raters to be relevant and important to each of the three accurate diagnoses. One cue relevant from the nursing report, "admitted three days ago" was also considered to be relevant by the 3 raters to the diagnoses: sensory deprivation and confusion related to time of day/environment (Sundowner's).

Two raters commented the cues in Appendix K were "context bound" and therefore often difficult to assess without having seen the simulated materials (e.g. the male nurse being called Elsie may be rated differently depending on how "masculine-appearing" or "feminine-appearing" the nurse was). A suggestion was made that if the panel were to validate the specific cues in the simulated materials, they should have access to the simulated materials. On the other hand, if the raters' task was to validate general cues related to the simulated materials, it is unnecessary to have access to the simulated materials. In future studies of this nature, the cues from the simulated materials could be translated to general cues and then given to a naive panel of raters (i.e. raters who have not seen the simulated materials) to validate. Nonetheless, despite not having had access to the simulated materials, the panel of raters were able to validate all the relevant cues in at least one of the diagnoses. It is suggested that the method employed in the current study for establishing content validity of the simulated materials shows promise and merits further development.

In conclusion, a review of the data related to the reliability and validity of the simulated materials suggests a high degree of

inter-rater agreement with respect to relevant cues and an adequate measure of content validity. It was beyond the scope of the present study to validate that the three accurate diagnoses noted in Appendix H were in face accurate, although that is a task which ought to be considered in future studies of this nature.

With respect to a measure of construct validity of the videotaped simulation and nursing report, an approach could be taken to administer the instruments (according to the procedure to be described in the next section) to the nurse subjects who are currently practicing and compare their performance with that of a "preprofessional" group (McLaughlin et al., 1981) of first year nursing students or non-nursing students (Page and Fielding, 1980). The more experienced nurses should be more proficient in identifying the pertinent cues and formulating diagnostic hypotheses.

It should be noted that attempts to establish construct validity of written simulations have generally been unsuccessful. Holzemer and associates (1981) examined the differences between certificate-prepared nurse practitioners and master's-prepared nurse practitioners on performance of a PMP representative of the caseload of an adult or family nurse practitioner. No significant differences were found between the two groups on the performance of the PMP. In addition, the investigators found a relatively high correlation ($r=0.54$) between scores on multiple choice exams to test knowledge of acute pneumonia and chronic obstructive lung disease and PMP scores, which suggests the two instruments were measuring the same construct. (The principle underlying patient management problems is that a PMP taps another

dimension of cognitive knowledge, i.e. problem solving ability.)

Goran, Williamson, and Gonnella (1973) compared the performance of physicians on a PMP problem and the actual clinical situation with respect to the treatment of urinary tract infections. Physicians asked more questions with the PMP and tended to order more diagnostic tests than in the real situation (although as noted by Farrand et al., 1982, results in the clinical situation may be more reflective of poor charting than actual clinical performance). Further, performance on the PMP did not discriminate among poor, average and excellent clinical performance.

Finally, Page and Fielding (1980) attempted to examine the criterion validity of a set of PMP's "through direct behavior-by-behavior comparison of (pharmacist) performance on the PMP's and performance in the practice setting" (p. 529). They found there were major inconsistencies (e.g. greater errors of omission and commission in the practice setting) between PMP performance and practice performance. These data suggest, as Vu (1979) observed, that much work remains to be done on establishing construct and concurrent validity with simulations. Further it remains to be "empirically demonstrated which features of reality are essential for inclusion in a simulation" (Vu, 1979, 304).

The results of the current study follow in chapter five.

CHAPTER FIVE

DATA ANALYSIS

A. Introduction

This chapter describes the data analysis methodology and the results of the research questions described in chapter four. The transcribed protocols from all ten subjects were subjected to content analysis with respect to: 1) the number and kind of inferences activated; 2) the types and numbers of cues used to activate the inferences; and 3) the timing of activation of inferences. In addition, the results of the written examination were tabulated. A description of the coding procedure and the results obtained follows.

Two pairs of raters, one from Edmonton and one from the Tanner research team in Portland, Oregon, analyzed the transcribed verbal protocols using the methodology developed by Tanner and associates (1982, ongoing). A flow chart of each subject's verbal protocol was generated by each rater using the code system described in Appendix L. For example, if the subject, after viewing the videotape, said "Mr. Seymour is confused", that would be coded (confused)^{v}. The ( ) indicates that the contained word was a cue and the "v" indicates that the cue originated in the videotape. Thus the number of cues, inferences, questions, instances of "thinking aloud" and so forth could be identified. If the subject pursued the same line of inquiry with respect to identifying a problem, this was indicated with all data displayed in a vertical line. If the subject shifted her thinking to another problem the data were displayed laterally. Thus, the number of

shifts a subject made in thinking as she proceeded through the diagnostic workup could be identified. See Appendix M for a sample of a coded transcript.

The Tanner research team calculated the interrater reliability of the transribed protocols (simulation #10) in their research by determining the percent agreement between the number of inferences identified and the number of columns/subject ("shift") for each transcribed protocol. A level of 0.83 percent agreement was achieved. All differences among the Tanner research team were reconciled through discussion. For the purposes of the current research, an a priori interrater agreement of 0.70 was the minimum percentage agreement acceptable between pairs of raters on the numbers of inferences activated and the number of "shifts" per subject. All differences, however, were reconciled between raters before further data analyses was conducted.

Prior to independently coding the verbal transcripts, the two Edmonton raters (the writer and one other nurse[7]) familiarized themselves with the simulation materials for simulation #10 and simulation #5 (See Appendices C and D). Following this, the two raters

[7]The other rater was a baccalaureate prepared nurse with advanced educational preparation in psychiatric nursing and graduate level university courses in research and statistics. In addition, the rater had more than 20 years experience as a clinical nurse, educator and administrator.

together coded the transcription of one of the pilot subjects for simulation #10. Following a discussion and review of the coding procedure, each Edmonton rater independently coded the transcription of the second pilot subject for simulation #10 to establish interrater agreement. The overall percentage agreement between the two raters on that transcription was 0.66.

As that percent agreement did not meet the a priori level of 0.70, further discussion took place between the two raters with respect to the coding procedure. Another transcription (simulation #5) from one of the pilot subjects was independently coded by the two raters and the mean percentage agreement between the number of inferences and the number of "shifts" for that transcription was computed to be 0.79. All differences were reconciled between the two raters. Since the a priori interrater agreement had been achieved, the two raters independently coded the transcriptions for all ten subjects on simulation #10.

The interrater reliability as measured by percent agreement between the two Edmonton raters for number of shifts on all transcriptions was 0.79, and for the number of inferences for all transcriptions was 0.78 for a mean interrater percent agreement of 0.785. Again all differences between the two raters were reconciled.

The transcriptions for the ten subjects from the current research were also analyzed by pairs of raters from the Tanner research team in

Portland, Oregon. Again the interrater agreement as measured by percent agreement on number of inferences activated/subject and the number of shifts of thought/subject were calculated. The percent agreement for the former was 0.85 and for the latter was 0.83 for an overall mean percent agreement of 0.84. All differences between pairs of Portland raters were reconciled.

As a final measure of interrater reliability, the number of inferences and number of shifts between the final coded transcriptions from the Edmonton raters and the Portland raters were compared for percent agreement. With respect to the number of shifts of thought, intergroup percent agreement was calculated to be 0.85, while percent agreement for the number of inferences was calculated to be 0.77, with a mean percent agreement between the two measures of 0.81. All differences between the two groups were reconciled. These interrater agreement percentages suggest the coding procedure yielded an adequate degree of interrater agreement.

Once all the transcriptions were coded and the interrater agreements calculated, quantitative analysis of the data was carried out. As described in chapter three the test procedure for the current research varied from the original procedure developed by Tanner and associates (1982, ongoing) in that subjects in the current study could ask for information after hearing the nursing report but <u>before</u> seeing the videotape. Thus there was a natural break in the procedure which was designated at the point at which the subject asked to see the videotape. Another natural break in the test procedure occurred when

the subject summarized her conclusions after obtaining all the information she required. All data, therefore, were analyzed in three components: data generated before seeing the videotape, data generated after seeing the videotape and data generated in the summary of the diagnostic workup.

The results of the data analysis follow.

B. Results of Research Questions

Research Question Number 1

The number and kinds of inferences activated by each subject were computed. An inference was defined as a conclusion or judgment made by the registered nurse, on viewing a videotaped, simulated nurse-patient encounter, about the state of the patient. An inference goes beyond the information or data present in the videotaped simulation or nursing report (Kelly, 1964; see Definitions). Table 3 provides definitions and examples for the six categories of interences derived from the data. Due to the ambiguity and general nature of the statements in the sixth category ("Other Inferences")[8], those inferences (18%) were omitted from further data analyses.

[8]Other inferences seemed to be of two types: i) general statements (e.g. "lots of problems", "something wrong", "other problems", and ii) inferences related to diagnostic tests and/or symptoms (e.g. "chest pain", "temp. not high", "0_2 low".

TABLE 3

CATEGORIES OF INFERENCES:*

SIMULATION #10

Accurate Hypothesis (AH): A correct explanation for cues presented in the situation which are of immediate concern. In this situation, an accurate hypothesis was one which explained the patient's disorientation. There are three subject hypotheses. They are sensory deprivation, reaction to Cimetidine, and Sundowner's Syndrome (disorientation related to new environment and time of day).

Plausible Hypothesis (PH): A possible but incorrect explanation for cues presented in the situation which are of immediate concern. Sufficient information was available to the subject, if s/he asked for it, to rule out these hypotheses. In this situation there was 12 such hypotheses. Examples are insulin reaction, delirium tremens, and hyperglycemia.

Implausible Hypothesis (IH): A highly unlikely explanation for cues presented in the situation. In this situation examples are frustration, chest pain and "giving up".

Related Hypothesis (RH): A possible explanation for cues other than those which are of immediate concern. In this situation, examples are ulcer disease from alcohol intake and compliance with diabetic diet.

Nursing Action Inference (NAI): A generalization drawn from cues which provides more precise delineation of specific or individualized action, but which does not provide an explanation for the cues. In this situation, an example is [patient] "needs oxygen" and "antibiotic coverage".

Other Inference (OI): A statement or generalization which goes beyond the cues but which lacks sufficient precision to be classified. In this situation, an example is "nasty combination of things".

* used with permission of Dr. C. Tanner.

The number of inferences activated by the subjects before and after viewing the videotape was calculated. See Appendix N for kinds of inferences by category for all subjects. Even if an inference was

repeated by a subject during the diagnostic workup, it was counted only once. It should be noted it was not possible for a subject to activate any accurate or plausible hypothesis before viewing the videotape. As well, the total number of inferences the subjects activated when summarizing the patient's problems was calculated. To equalize the number of inferences across subjects, the inferences were calculated using proportions. See Table 4 for the proportion and standard deviation for inferences activated in each of the six categories of inferences according to sequence in diagnostic workup for all ten subjects.

TABLE 4

PROPORTION[a] AND STANDARD DEVIATION

OF INFERENCES ACTIVATED BY DIAGNOSTIC

CATETGORY AND SEQUENCE IN DIAGNOSTIC WORKUP

Sequence in Diagnostic Workup	Diagnostic Category						
	Accurate Hyptheses Prop. (S.D.)	Plausible Hypotheses Prop. (S.D.)	Related Hypotheses Prop. (S. D.)	Implausible Hypotheses Prop (S.D.)	Nursing Action Inference Prop. (S.D.)	Other Inference Prop (S.D.)	Average Prop (S.D.)
Before viewing Videotape	Not Applicable	Not Applicable	.62 (.35)	.10 (.32)	.10 (.32)	.18 (.16)	.27 (.22)
After viewing Videotape	.11 (.07)	.42 (.21)	.18 (.12)	.09 (.13)	.03 (.05)	.17 (.13)	.54 (.20)
Summary: Diagnostic Workup	.14 (.17)	.36 (29)	.23 (.22)	.08 (.13)	.09 (.19)	.10 (.10)	.19 (.10)
Percentage of Total Number Inferences	7	26	37	7	5	18	

[a]N=10 Subjects [b]Prop.=Proportion [c]S.D.=Standard deviation

Twenty-seven percent of inferences (all categories) were activated by subjects before viewing the videotape, 54% of inferences were activated after viewing the videotape, and 19% of inferences were activated in the summary. There was a significant difference between the numbers of inferences (total) activated pre-V.T.R. and the number activated post-V.T.R. (including the summary ($t_{(9)}$= =2.59, $p \leq 0.05$), but it should be noted that the likelihood of generating accurate or plausible hypotheses before the videotape is low. Each subject activated at least 11 inferences when all inferential categories were considered. The number of inferences per subject in all categories ranged from 0 to 11 pre-videotape, from 5 to 36 post-videotape and 2 to 5 in the summary. Seven percent of all inferences were accurate hypotheses with 26% being plausible hypotheses. Thus approximately 1/3 of all inferences activated were of the accurate and plausible category. Thirty-seven percent of all inferences activated were related hypotheses, 7% were implausible, 5% were nursing action inferences and 18% were other inferences.

With respect to accurate diagnostic hypotheses (post videotape segment only), no subject activated all three hypotheses. One subject did not activate any accurate diagnostic hypothesis. Two subjects activated two accurate diagnostic hypotheses: side effect of cimetidine and confusion, related to absence of glasses and/or hearing aids. The remaining seven subjects each activated one accurate diagnostic hypothesis (five subjects activated the hypothesis "confusion related to no hearing aids and/or glasses", one subject activated the hypothesis "confusion related to new environment" and one subject activated the

hypothesis "side effect of cimetidine".).

Plausible hypotheses were those considered as possible explanations for the patient's confusion but which could have been ruled out with more thorough information gathering. Twenty six percent of all inferences were of the plausible hypothesis category. All ten subjects activated plausible hypotheses related to diabetes and/or blood sugar levels. Seven subjects activated plausible hypotheses related to oxygen deprivation, five subjects activated plausible hypotheses related to alcohol and four were activated related to elevated temperature. There were 15 different plausible hypotheses activated by all subjects.

The majority of inferences activated (37%) were of the related hypothesis category (e.g. the patient may have an ulcer or pancreatitis) and those inferences were activated primarily pre-videotape (Wilcoxon sign test = 1, $p \leq 0.05$) and primarily by three subjects. The fewest inferences activated (5%) were of the nursing action category (e.g. the patient should have oxygen or a re-breathing mask). There was no significant difference with respect to sequence in diagnostic workup and activation of nursing action inferences ($t_{(9)}=1.0$, n.s.).

Five subjects (50%) did not activate any implausible hypotheses and six subjects (60%) did not activate any nursing action inferences. All subjects considered plausible, related and "other" hypotheses somewhere in their diagnostic workup. See Table 5 for the number of subjects who activated at least one inference, by inferential category and sequence in diagnostic workup.

Table 5

NUMBER OF SUBJECTS[a]

WHO ACTIVATED AT LEAST

ONE INFERENCE, BY CATEGORY

AND SEQUENCE IN DIAGNOSTIC WORKUP

	Category of Inference					
Sequence in Diagnostic Workup	Accurate Hypothesis N (Prop.)[b]	Plausible Hypothesis N (Prop.)	Related Hypothesis N (Prop.)	Implausible Hypothesis N (Prop.)	Nursing Action Inference N (Prop.)	Other Inferences N (Prop.)
Before Viewing Videotape	Not applicable	Not applicable	8 (.50)	1 (.06)	1 (.06)	6 (.38)
After Viewing Videotape	9 (.21)	10 (.23)	8 (.19)	5 (.11)	3 (.07)	8 (.19)
Summary: Diagnostic Workup	3 (.11)	9 (.32)	6 (.21)	3 (.11)	2 (.07)	5 (.18)

[a]Total N = 10 subjects

[b]Prop. = proportion

In addition to the number and kind of inferences activated, the number of shifts in thinking while proceeding through the diagnostic workup was computed. It is suggested a shift in thinking is indicative of thoroughness in information gathering, with respect to inferences. As noted in the introduction to this chapter, a "shift" was defined as a line of inquiry generated by each subject related to one problem. For example, if the subject asked a number of questions about the simulated patient's diabetes and then asked a question about his usual place of residence this would be indicated as a shift in thinking. The mean number, proportion and standard deviation of shifts in thinking pre- and post-videotape and in the summary was calculated and is found in table 6.

TABLE 6

MEAN[a] PROPORTION AND STANDARD DEVIATION OF SHIFTS IN THINKING DURING DIAGNOSTIC WORKUP

Place in Diagnostic Workup	Mean (S.D.)[b]	Proportion (S.D.)
Before Viewing Videotape	6.2 (6.2)	.24 (.17)
After Viewing Videotape	10.9 (4.8)	.49 (.21)
Summary: Diagnostic Workup	6.5 (3.7)	.27 (.099)
AVERAGE	23.6 (7.7)	

[a]N=10 Subjects

[b]S.D.=standard deviation

The mean number of shifts in thinking by subjects before seeing the videotape was 6.8 (24% of all shifts), after seeing the videotape was 10.9 (49% of all shifts) and in the summary was 6.5 (27% of all shifts). The range in number of shifts of thought was 1 to 20 pre-videotape, 6 to 21 post-videotape, and 2 to 14 in the summary. As the ranges suggest, there was a wide variation among subjects with respect to information gathering techniques (as measured by "shifts" of thought). One subject shifted her line of thought 43 times during the diagnostic workup. The fewest total shifts of thought by one subject was 15. The percentage of accurate and plausible Hypotheses activated by all subjects (post VTR and summary) was correlated with number of shifts in thinking (post VTR and summary) and was computed to be r=-0.70 (P.P.M.). Thus, the more shifts in thinking a subject made, the less likely they were to activate accurate and plausible hypotheses.

Research Question Number 2

As a measure of information gathering strategies, the number and type of cues and the number of questions asked during the diagnostic workup was calculated. (See chapter four: definitions, for a definition of cue). In addition, each cue was categorized according to source: that is, did the cue originate in the nursing report, in the videotape or in the followup materials. The proportion and standard deviation of both cues utilized and questions asked by all subject in found in table 7.

TABLE 7

PROPORTION[a] AND STANDARD DEVIATION

OF CUES UTILIZED AND QUESTIONS

ASKED DURING DIAGNOSTIC WORKUP

	Before Viewing Videotape[c] Prop.[b] (S.D.)	After Viewing Videotape[d] Prop. (S.D.)
Cues Utilized	0.39 (.23)	0.61 (.23)
Questions Asked	0.46 (.32)	0.54 (.32)

[a]N=10 Subjects
[b]Prop.=Proportion
[c]Includes information from nursing report and/or follow up information.
[d]Includes information from nursing report, videotape and/or follow up information. Does not include diagnostic summary.

Before asking to see the videotape 39% of the cues were utilized, with the range being 2 to 18 cues. In addition, 46% of questions were asked pre-videotape, with the range being 1 to 26 questions. There was no significant difference pre and post videotape with respect to the number of cues utilized ($t_{(9)}=1.47$, n.s.). The wide variation in number of cues utilized and number of questions asked is a reflection of the amount of time each subject took during the diagnostic workup prior to seeing the videotape (See research question #3), r= 0.95 (P.P.M.) - Correlation between proportion cues, pre-V.T.R. and time (mins.). For example, one subject took only 45 seconds to gather information prior to asking to see to videotape, while another subject took 15.7 minutes (the longest time) prior to seeing the videotape. The former subject

utilized three cues and asked two questions, while the latter subject utilized 18 cues and asked 26 questions.

In the post-videotape component (not including the diagnostic summary) 61% of the cues were utilized with a range of 6 to 43 cues, while 54% of the questions (range of 4 to 19 questions) were asked. Again the relationship between the number of cues utilized and the number of questions asked was reflective of the length of time taken by the subjects to complete the diagnostic workup, after seeing the videotape although to a lesser degree than pre-V.T.R. (r=0.61, P.P.M.). For example, the subject who took the least amount of time to complete the diagnostic workup post-videotape (4.75 minutes) utilized six cues and asked six questions. This was also the subject who took the longest time to gather information prior to seeing the videotape[9]. The subject who took the longest time post-videotape to complete the diagnostic workup (18.25 minutes) utilized 29 cues and asked 11 questions. The subject who utilized the most cues (N=43) and asked the most questions (N=9) post-videotape was tied with another subject for taking the second longest amount of time to complete the diagnostic workup post-videotape (16.75 minutes).

The cues were also examined pre- and post-videotape according to source: nursing report, videotape and follow-up information. The proportion and standard deviation of cues utilized, according to source, and mean number of cues used (total), is found in Table 8.

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[9]This subject activated 1 accurate, 6 plausible and 2 related hypotheses in the post-V.T.R. component of the diagnostic workshop.

TABLE 8

PROPORTION[a] AND STANDARD DEVIATION OF CUES UTILIZED, BY SOURCE AND SEQUENCE IN DIAGNOSTIC WORKUP AND MEAN NUMBER CUES USED (TOTAL) BY SOURCE

Source of Cue	SEQUENCE IN WORKUP: Before Viewing Videotape Prop.[b] (S.D.)[c]	SEQUENCE IN WORKUP: After Viewing Videotape[b] Prop. (S.D.)	Mean Number of Cues Used (Total)
Nursing Report	0.79 (.17)	0.26 (.16)	11.8
Videotape	Not Applicable	0.34 (.18)	4.5
Follow Up Information	0.21 (.17)	0.40 (.19)	9.2

[a]N=10 Subjects
[b]prop=Proportion
[c]S.D.= Standard Deviation
[d]Does not include diagnostic summary

Pre-videotape, 79% of the cues utilized were from the nursing report, with a range of 2 to 14 cues, while 21% of cues utilized were from the follow-up information, with a range of 0 to 7 cues. Four of the 10 subjects focused on the cue "pneumonia" to initiate the information gathering, while 2 subjects each focused on "abdominal pain" and the patient's age to initiate the diagnostic workup. One subject focused on the cue "history of alcoholism" while the remaining subject focused on the dosage of NPH insulin to initiate the diagnostic workup.

Post-videotape, 26% of cues utilized were from the nursing report, (range of 1 to 14); 34% were from the videotape, (range of 1 to 12); and 40% were from the followup information (with a range of 0 to 16 cues).

Post-videotape, the first cue noted by all ten subjects related to the simulated patient's confusion and/or disorientation. The cue "confusion" resulted in the initial activation of accurate hypotheses by two subjects (no glasses and hearing aids; response to new environment), of plausible hypotheses by 5 subjects (alcohol withdrawal-2; dreaming, diabetic reaction, and fever), and one each of a related hypothesis (diabetic retinopathy), an other inference ("something wrong") and an implausible hypothesis ("really frustrated"). Cues that led to accurate inferences (in addition to confusion/disorientation):

Accurate Hypothesis	(Cue)
1) new environment -	(elderly gentlemen) (in hospital from retirement centre)
2) side effect cimetidine -	(elderly) (on I.V. med) What med? (N=3 looked up cimetidine)
3) no hearing aid and/or glasses -	(hearing aids/glasses on table) (patient didn't open eyes)

Three subjects did not identify and/or utilize the cue "glasses and hearing aids on the overbed table" which precluded them from identifying one of the accurate hypotheses-confusion related to absence of glasses and hearing aids. One subject did not identify the hearing aids, but she did note the patient's glasses and thus inferred the patient may not be able to see because of diabetic retinopathy. In total, (post-V.T.R. only) more verbal cues (66%), as measured by the cues utilized from the nursing report and the followup information, were utilized by all subjects than visual cues (34%), as measured by cues utilized from the videotape.

Although the specific number of cues/subject was not tabulated, it is interesting to note that an average of 11.8 cues from the nursing report was used by all subjects (Table 8). Since there were only 12 relevant cues in the nursing report (see Appendix H), virtually 100% of the information in the nursing report was used by the subjects at some point during the diagnostic workup. Conversely, approximately 50% (x=4.5) of the eight relevant cues from the videotape were utilized by all subjects.

The number of subjects who requested information from the reference books available (the drug compendium and normal blood values) was also calculated. Three subjects reviewed information in the drug compendium related to cimetidine and subsequently activated the accurate hypothesis that the patient's confusion was possibly related to a side effect of cimetidine. Two subjects requested information about normal blood gas values, which unfortunately were not available in the laboratory values handout.

Although few subjects requested information from reference materials, those who did were successful in identifying one of the accurate hypotheses. This suggests practising nurses and student nurses should be encouraged to utilize reference materials to supplement their existing knowledge bases.

Research Question Number 3

Prior to calculating the timing of inference activation, the amount of time each subject spent completing the diagnostic workup was calculated in 3 intervals: 1) the time taken prior to seeing the videotape; 2) the time taken after seeing the videotape; and 3) the time

taken during the summary. In addition, the time at which the first inference was activated both pre- and post-videotape was calculated. See Table 9 for the mean times pre-, post-videotape and in the summary and the mean times for activation of the first inference.

TABLE 9

MEAN[a] TIMES TAKEN TO COMPLETE THE DIAGNOSTIC WORKUP AND MEAN TIMES OF ACTIVATION OF FIRST INFERENCE

Place in Diagnostic Workup	Time Taken in (Minutes) to Complete Diagnostic Workup		Time (in minutes) of Activation of First Inference[c]	
	$\bar{X}$	S.D.[b]	$\bar{X}$	S.D.
Before Viewing Videotape	6.9	5.5	0.85	(.66)
After Viewing Videotape	9.9	5.8	0.5	(.38)
Summary: Diagnostic Workup	3.0	2.1	--	--
Total	19.8	6.7	--	--

[a]N=10 Subjects
[b]S.D.= Standard Deviation
[c]After Viewing Videotape

The mean amount of time taken by subjects during the diagnostic workup prior to viewing the videotape was 6.9 minutes (range: 0.75 to 15.75 minutes). The mean time taken for activation of the first inference prior to viewing the videotape was 0.85 minutes (range: 0 to 15 minutes). Two subjects did not activate any inferences prior to viewing the videotape. The mean time taken by subjects to complete the

diagnostic workup, after viewing the videotape, was 9.9 minutes (range: 5 to 18.25 minutes). Three subjects took longer than 16 minutes to complete their diagnostic workup, once they had seen the videotape. The mean time for activation of the first inference after seeing the videotape was 30 seconds (range 15 seconds to 1.45 minutes). The mean amount of time taken to activate an accurate diagnostic hypothesis (if any) was 3.7 minutes (range 15 seconds to 12.5 minutes). In summary, the mean amount of time taken to complete the diagnostic workup was 19.8 minutes (range: 8.75 mins. - 30 mins.).

To determine the timing of inference activation[10], each subject's transcript was divided into quartiles and the number of inferences in each quartile was counted. Those inferences activated during the first quartile were assigned a weight of 1, those in the second quartile a weight of 2, those in the third quartile a weight of 3 and those in the fourth quartile a weight of 4. The sum of the number of inferences in each quartile multipled by the weight was divided by the total number of inferences activated by that subject to yield a timing score. The higher the score, the later in the overall diagnostic workup the inferences were activated.

Table 10 shows the mean number of inferences per quartile and the mean timing score for all subjects. The mean number of inferences was approximately evenly divided among all four quartiles, with 4.6 inferences activated in the first quartile, 4.4 in the second, 5.7 in the third and 5.3 activated in the fourth. The mean timing score of 2.7 suggests that the mean number of inferences in total were activated between the second and third quartiles of the diagnostic workup.

TABLE 10

MEAN[a] NUMBER OF INFERENCES

PER QUARTILE AND MEAN TIMING SCORE

1st Quartile $\bar{X}$ (S.D.)[b]	2nd Quartile $\bar{X}$ (S.D.)	3rd Quartile $\bar{X}$ (S.D.)	4th Quartile $\bar{X}$ (S.D.)	Timing Score $\bar{X}$ (S.D.)
4.6 (2.2)	4.4 (1.8)	5.7 (3.5)	5.3 (2.8)	2.7 (2.8)

[a]N=1- Subjects
[b]S.D.= Standard Deviation

Finally, the coded transcripts of all subjects were inspected to determine if the subjects utilized a model of diagnostic inquiry similar to the one identified by Elstein and associates (see chapters two and three). All subjects gathered data and generated a hypothesis very early in the diagnostic workup. In addition, all subjects, to some extent clarified their initial hypotheses in light of new information and then reached a diagnostic decision. For instance, one subject after seeing the videotape, noted the patient's confusion and stated it could be related to alcohol withdrawal. (A cue in the nursing report stated the patient had a history of alcoholism) This subject then asked how recently the patient had had a drink. On receiving the information that the patient had not had a drink in 10 years, the subject ruled out confusion related to alcohol withdrawal as a possible cause of the patient's confusion. Although not the focus of this study, this suggests subjects appear to use a diagnostic model of inquiry. More

[10]Methodology used with permission of Dr. C. Tanner, December, 1984.

research needs to be undertaken to substantiate this suggestion. No subject asked for all the information related to the patient before activating a diagnostic hypothesis, which would have been more reflective of a nursing process model of inquiry.

C. Written Examination Results

The written examination was designed to assess knowledge of the content related to the simulated materials. A 41 item examination was administered to all subjects. Twenty-eight of the 41 items related specifically to simulation #10 (see chapter four for a discussion of the construction of the written examination). Raw scores on the 28 item written examination were tabulated for each subject. The mean, standard deviation, and median scores for the 28 item examination are found in table 10.

TABLE 11

WRITTEN EXAMINATION RESULTS:

MEAN[a] AND MEDIAN

Examination	Mean[b] (%)	Median[c] (%)
28 item examination	18.5 (66.1)	20 (71.4)
20 item examination	12.9 (64.5)	14 (70)

[a]N=10 Subjects
[b]S.D.= 4.53
[c]S.D.= 2.96

The mean raw score for the 28 item examination was 18.5 (66.1%) with the range being 8 (28.6%) to 23 (82.1%). Since there was such a wide range of scores, the median score was also computed and was found to be 20 (71.4%). Three subjects scored less than 60% on the examination, two

of whom received their basic nursing education at hospital schools of nursing outside Canada, and one of whom received her basic baccalaureate degree in nursing in Canada. The subject with the lowest mark was also the oldest subject. The mean raw score (without subjects who scored <60%) was 20.8 (74.5%).

To determine if any relationship existed between exam results and accurate and plausible inference activation or cue utilization, correlational coefficients were computed. The correlation between proportion of accurate and plausible hypotheses (post-V.T.R. and summary) and exam results (/28) (r-0.63, P.P.M.), suggests cognitive knowledge is related to inference activation. The correlation between number of cues utilized (total) and exam results (r=-0.17), suggests these two components are not related.

As described in Chapter four (written examination) two topics, electrolyte balance and diabetes/insulin, were over-represented in the 28 item written examination. In an attempt to improve the content validity of the written examination the number of items (N=16) related to electrolyte balance and diabetes were reduced by one-half to yield a 20 item examination. Examination results, including the mean score, standard deviation and median score, are found in Table 10.

The mean raw score for the twenty item examination was 12.9 (64.5%) with a range of 7 (35%) to 16 (80%). As can be seen from the standard deviation, the effect of decreasing the number of items on the examination was to decrease the variation among subjects. The same two subjects scored the lowest and highest on the 20 item examination as on the 28 item examination. Again the same three subjects scored less than

60%. The subject who scored the lowest on the 28 item examination did improve her score on the 20 item examination by seven percentage points. The median score on the 20 item examination, 14 (70%), was very similar to the median score (71%) on the 28 item examination.

A discussion of the implications of the examination results, together with a discussion of all the research results, follows in chapter six.

CHAPTER SIX

DISCUSSION, LIMITATIONS AND SUGGESTIONS FOR FURTHER STUDY

A discussion of the results, the conclusions, significance for nursing, study limitations and suggestions for further study will be delineated in this chapter.

A. Discussion

This descriptive study focused on the diagnostic reasoning strategies of a small group of expert nurse clinicians. The clinicians' research task was to identify a simulated patient's problem(s) which were amenable to nursing intervention. This discussion will focus on the types of inferences activated by the subjects, the cues utilized to activate those inferences and the timing of inference activation. Where applicable, results of the study will be contrasted with results of Tanner and associates' study (1982, ongoing) as it relates to the sample of clinical nurses.

Subjects in the current study activated an average of 10.7 inferences (54% of all inferences) (post-videotape segment only) compared with 7.2 inferences activated by the expert clinicians in Tanner's study. Moreover, the range of number of inferences activated was greater for the former group of subjects (5 to 36 inferences) than for the latter group (2 to 15 inferences).

The slightly increased mean number of inferences activated by the subjects in the current study may be accounted for by differences in the test procedure between the two projects. Subjects in Tanner's study

were time-limited (they were allowed no more than twenty minutes to complete the diagnostic workup), while subjects in the current study were not time-limited. Most subjects in Tanner's study completed the diagnostic workup in less than fifteen minutes, while an average of nearly twenty minutes was taken by the subjects in the current study. Thus, the greater amount of time taken to complete the diagnostic workup in the current study could have lead to activation of more inferences.

In addition, subjects in the current study could ask for information after hearing the nursing report but before seeing the videotape, whereas subjects in Tanner's study saw the videotape immediately after listening to the nursing report. It appears subjects in the current study used the additional time to advantage in that they utilized 11.8[11] of 12 possible cues from the nursing report. In addition, there were a large number of related hypotheses activated by the subjects in the current study prior to seeing the videotape. These inferences were often carried over to the post-videotape segment of the diagnostic workup, which may have accounted for differences in number of inferences activated between the two groups.

Finally, there were three subjects in the current study whose native language was not English. One of those subjects activated the most implausible hypotheses (N=6) (19% of all inferences she activated) and had the most shifts in thinking (N=43). This subject reported it was difficult to think aloud and she often paused throughout the thinking aloud procedure. This difficulty in language may have contributed to

[11]Average across all subjects, throughout the disgnostic workup.

the activation of more hypotheses than the Canadian subjects, simply because this subject had difficulty expressing herself. She often activated more than one inference per thought - e.g. "The patient is dreaming, he is frustrated, he is giving up."

With respect to the activation of accurate hypotheses, no subject activated all three accurate hypotheses. Eighty percent of the subjects activated one or less of the 3 possible accurate hypotheses. This is indicative of the problems nurses have identifying accurate hypotheses or identifying correct problem problems from simulations. (See for example, Aspinall, 1979: 40% of her subjects identified one or none of 6 possible correct problems from a written case study). Only one subject activated the hypothesis "unfamiliarity with environment" (taken to be equivalent to Sundowner's syndrome). It was not unexpected that "Sundowner's syndrome" per se, was not activated as this is not a term in common useage in Canadian nursing. However, it should be noted that one nurse identified the inference considered to be equivalent to Sundowner's syndrome, while nine other subjects did not. It is possible subjects had problems with diagnostic nomenclature similar to the problems reported by Aspinall (1979) and Gordon, Sweeney, and McKeehan (1980). For example, no subject used the term "sensory deprivation" to identify the simulated patient's problem related to his not wearing his glasses and hearing aids, although six subjects activated the more simple inference "confusion related to absence of hearing aids and/or glasses". Sensory deprivation is not a new term in psychological

literature[12], nor is it a new term in nursing literature[13]. It is impossible to determine if the subjects' inability to activate the inference "sensory deprivation" was related to unfamiliarity with the term or to inferring the simulated patient did not have sensory deprivation.

Again there were differences among subjects with respect to the inference "confusion related to side effect of cimetidine". Only four subjects activated that inference. That included three subjects who reviewed the drug in the drug compendium. Four other subjects did ask about the type of medications the patient was receiving and were told about cimetidine. They did not ask to review the information in the drug compendium nor did they associate confusion with a possible side effect of cimetidine. That cue, therefore, was not sufficient to stimulate further information seeking in those subjects. That finding may be indicative of a knowledge deficit amoung the subjects, related to cimetidine, but that cannot be further explored as there was no test item on the written examination related to cimetidine.

Further, it may be that the inability of the subjects to associate cimetidine with confusion was a function of the subject's clinical experience. The four subjects who correctly activated the hypothesis were surgical nurses (N=2) or nurses who worked with surgical patients

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[12]Experiments were begun in the area of sensory deprivation in the mid 1950's. See Morris, C.G. Psychology: An Introduction. Englewood Cliffs, N.J.: Prentice-Hall Inc., 1976.

[13]Rosemary Ellis reported on the experiences of surgical patients with eye patches, at a conference in 1967 - See Kintzel, K.C. (Ed). Advanced concepts in clinical nursing, Toronto: J.B. Lippincott, 1971.

(N=2, isolation unit). Cimetidine is a medication that would likely be used more frequently on surgical units since it is a treatment for gastric ulcers. It seems likely that the subjects who knew the patient was receiving cimetidine yet did not associate that with the patient's confusion were distracted by the fact that the patient was on cimetidine, as they expressed surprise that an individual with generalized abdominal pain and no history of ulcers should be on cimetidine.

When comparing the subjects who activated two of the three accurate hypotheses with amount of clinical experience, those subjects were from the group of least experienced subjects (2-4 years of clinical experience). Although the number is very small and therefore statistical significance testing could not be done, this finding is similar to that of Davis (1972, 1974) and Aspinall (1979), who found that increasing years of clinical experience is associated with decreasing ability to identify patient problems/nursing actions accurately. On its face this finding appears to run contrary to the problem solving literature that suggests that expertness in a task is associated with practice and therefore, presumably more years of clinical experience. As noted in the literature review a possible explanation for this is the task in the current simulation were not specific to the clinical experience of the research subjects.

All subjects activated plausible and related hypotheses. Those two groups of inferences accounted for the majority of all activated inferences (63% of all inferences activated). With respect to plausible hypotheses, it is not unexpected that a large proportion of all

inferences activated were of this type. Aspinall and Tanner (1981) suggested that one difference between experts and novices with respect to diagnostic ability was in the number of plausible hypotheses considered, with experts considering more plausible hypotheses. Since there was no novice group with which to compare the results of the current study it is not known if that suggestion is supported in the current study. However, subjects in the current study activated a total of fifteen different plausible hypotheses which suggests consideration of a wide range of diagnostic inferences by this group of experts related to the patient's problem of confusion.

The large number of related hypotheses (total) activated by subjects in the current study is a somewhat unexpected finding in that one would expect expert clinicians to focus on the more salient features of the diagnostic task and not be distracted by related information (Westfall et al, 1985, in press). However, that finding is a function of the test procedure in that most of the related inferences were activated before the subject saw the videotape primarily by three subjects. It was not possible for a subject to activate accurate or plausible hypotheses before seeing the videotape. It was noted that many subjects made notes from the nursing report and reviewed this information and/or asked for more information prior to seeing the V.T.R., especially as it related to the abdominal pain, not yet diagnosed. It is suggested the break in the diagnostic workup between the nursing report and V.T.R. served a useful purpose in that subjects could initiate a more thorough information search.

With respect to implausible hypotheses, three subjects activated the most implausible hypotheses. To determine if any relationship existed between exam scores (/28) and implausible hypotheses (total), a correlation coefficient was computed (r=-0.32, P.P.M.). This suggests activation of implausible hypotheses may be, in part, a function of cognitive knowledge. Two of the subjects who activated the most implausible hypotheses, received their basic nursing education outside Canada. In addition, their English was difficult to understand. The implausible hypotheses they activated were such inferences as the patient is "frustrated", the patient is "giving up" which may be more indicative of language problems than of problems with diagnostic reasoning ability. It may be difficult for someone whose native tongue is not English to think aloud in English and to activate inferences in English. The Canadian subject who activated the most implausible inferences focused on meningitis as a possible inference even though there was no evidence to suggest the patient had meningitis or sepsis. This was an example of failure to use disconfirming data, a potential problem in the diagnostic process as identified by Aspinall and Tanner (1981).

The least amount of inferences activated were of the nursing action category (5%). These included such inferences as: the patient has a temperature, this consumes energy therefore he needs an I.V. of 5% D/W; the patient has a fever and pneumonia, his blood gases aren't good, therefore he needs oxygen and antibiotic coverage. The paucity of nursing action inferences is somewhat surprising given that the goal of nursing is to identify patient problems and initiate action based on

those problems. That finding may be a function of the coding categories in that nursing action inferences had to be drawn from cues and be a more precise delineation of specific or individual action. Those subjects who did not activate nursing action inferences did suggest more generalized nursing actions such as "I'd talk to the doctor", "I'd give the patient something for discomfort", I'd get additional blood work done."

It is interesting to note that one subject activated three diagnoses which were medically oriented: diabetic retinopathy, diabetic nephropathy and diabetic neuropathy. This finding is not unlike that of Gordon, Sweeney and McKeehan (1980) who speculated that activation of medically oriented diagnoses by nurses may be due either to lack of diagnostic nomenclature in nursing or to the nurse's inability to formulate a nursing diagnosis. The former reason is the more likely explanation for this finding as nursing diagnoses were not used routinely by the nurses in their clinical practice.

With respect to the number of questions asked and shifts of thought, again there seemed to be wide variation among subjects even given the relatively small sample (Table 7). Broderick and Ammentorp (1979) observed that expert subjects in their study asked for more information than did the novice subjects. Again it is difficult to compare the results in the current study against those results as there was no novice comparison group. But it can be noted that subjects in this study asked almost as many questions pre V.T.R as post V.T.R. Elstein's (1978) criterial physicians also asked for more information before activating their first hypothesis. This therefore, could be a function

of information gathering in experts. Alternately, this may reflect the tendency of some nurses to use a standardized format to gather information prior to seeing the patient. For instance, all subjects asked about the patient's abdominal pain (type, location, duration, severity, onset and so forth) prior to viewing the videotape.

There was wide variation, particularly pre-videotape, with respect to shifts in thought (Table 6). It is difficult to determine to what extent that could be attributed to personal information seeking strategies. One would have expected less variation if Elstein and associates' (1978) conclusions that the process of solving medical problems is content specific and not practitioner-specific. This can only be addressed in nursing by using different vignettes and examining each subject's problem-solving style to determine if it changes depending on the particular problem. It can be noted that shifts in thinking was negatively correlated with accurate and plausible hypotheses, which suggests emphasis in nursing education should be to encourage students to pursue one line of thought thoroughly, before moving to a new line of thought.

Subjects in the current study did not use all the cues available (and considered relevant) from the videotape. All subjects, however, did note the cue disorientation/confusion. It may be as Matthews and Gaul (1979) observed, that certain cues provide more informational value to a nurse when making a diagnosis. Informational value of cues, therefore, may be more important to the activation of accurate hypotheses than total number of cues used and/or available. This is an area which merits further study.

There was one very interesting finding in the current study related to cue utilization. Three subjects did not utilize the cue "glasses and hearing aids on the overbed table" even though the video camera focused on those objects on two different occasions. Notes, which were kept by the writer during the data collection procedure, were reviewed to determine if there were possible explanations for this finding. On review of those notes, one subject commented she saw the glasses and hearing aids but did not know what their significance was. That was the oldest subject who completed her post-baccalaureate degree in 1969 and, therefore, may not have been familiar with the concept of sensory deprivation. One subject did not utilize the cue and offered no explanation as to why, while the other subject mentioned seeing the glasses, but not the hearing aids, during the post-diagnostic workup validity check. An additional subject saw the glasses and correctly inferred that the patient's confusion could be related to his not wearing glasses, but she did not identify the hearing aids.

As described in chapter four, one of the individuals who assisted with the reliability assessment of cues in the videotape, could not clearly distinguish the hearing aids. It may be that the subjects in the current study also dismissed the relevance of the hearing aids because they could not clearly distinguish them. With a larger sample, it may be useful to examine the characteristics of individuals who did see the hearing aids with those who did not, to determine if there are types of visual cues to which some nurses are more sensitive.

An additional finding in the current study was that some subjects requested information that was not available in the simulated materials,

which replicates the finding of Baumann and Bourbonnais (1982) and Broderick and Ammentorp (1979). For example, some subjects asked for serum amylase levels to rule out possible pancreatitis related to alcoholism. Further, four subjects asked why the patient was on cimetidine if he had generalized abdominal pain and no history of ulcers. This finding may reflect the greater awareness of diagnostic possibility related to the clinical experience and expertise of the subjects.

Subjects in the current study demonstrated some of the problems that may occur in the diagnostic process related to cue utilization: e.g. 1) failure to associate initially available data with plausible diagnostic hypotheses, 2) failure to ask for disconfirming data (Aspinall and Tanner, 1981,), and 3) leaving some cues uninterpreted (Elstein and associates, 1978). For example, subjects were told during the nursing report that the patient had had an elevated temperature on the previous day. Only four subjects utilized that cue to determine if an elevated temperature could be contributing to the patient's confusion. One subject received information that the patient's current temperature was essentially normal, but still thought the patient's confusion could be related to sepsis or to meningitis. It is not clear whether those problems in cue utilization were a function of poor cognitive knowledge in the subjects or a lack of adequate cross-references in the subjects' long term memories such that the correct diagnoses could not be activated. In addition, it may be that some of the cues were too subtle for some subjects. The area of cue utilization and interpretation of cues during the diagnostic process requires further study.

Elstein and associates (1978) reported that at least one hypothesis was activated by their subjects at least 10 percent of the way through the diagnostic workup. Aspinall and Tanner (1981) noted that experienced clinicians formulate diagnostic impressions early in their encounter with the patient. Tanner and associates (ongoing) also reported that all their subjects activated diagnostic hypotheses early in the diagnostic workup. Those results were supported in the current study (Table 9). In fact subjects in the current study activated the first inference very soon after viewing the videotape. This may have occurred as a result of the information gathering that had preceded seeing the videotape. Even those subjects who took the least amount of time during the pre-videotape segment of the diagnostic workup, activated inferences quickly after seeing the videotape.

Two difficulties related to the written examination merit further discussion. As delineated in chapter four the validity of the written examination used in the current study was questionable. Therefore, efforts to relate written examination results to inference activation must be done with caution.

The mean written examination result for Tanner's expert clinician group was 75% while the mean examination result for subjects in the current study was 66%. One subject in the current study scored 29% which greatly affected the mean score. To take this into account the median score of the subjects in the current study was calculated (71%), which was found to be very similar to the mean score of the Tanner group. It is important to note, however, there may be differences between the Canadian and American educational system and/or clinical

practice that could make comparison of examination results between the two groups meaningless.

The two subjects who activated the most accurate inferences on the post-videotape segment of the diagnostic workup scored 78.6% and 64.3% on the written examination. To determine the relationship between exam scores (/28) and activation of accurate hypotheses (post-V.T.R. only), a correlation coefficient was computed (r=0.60, P.P.M.). This suggests, contrary to the speculation of McGuire, Soloman and Bashook (1976), that accuracy of hypothesis activation is related to cognitive knowledge. Therefore, it is not enough to teach students strategies of diagnostic inquiry. This must be coupled with a sound theory base.

B. Conclusions

Results on one component of the diagnostic reasoning process based on subject's responses to a single patient simulation have been presented. The following are conclusions that can be drawn from these results related to the study sample.

1. Activation of hypotheses is a component of the diagnostic reasoning process used by baccalaureate prepared registered nurses. Moreover, all subjects utilized other components of the diagnostic reasoning process--cue acquisition, cue interpretation and hypothesis evaluation--with varying degrees of skill and success.

2. Diagnostic hypotheses are activated by subjects very early in the diagnostic workup.

The inferential or diagnostic task is central to all nursing practice (Kelly, 1966). The results of the current study suggest that diagnostic reasoning is a complex construct; one that requires further

exploration and explication. In order to ensure that patients receive the best possible nursing care, it is not sufficient to teach nurses the steps of the nursing process, coupled with some medication and nursing knowledge related to symptomatology. More efforts must be directed to the development of diagnostic reasoning skills, particularly related to cue acquisition and hypothesis activation. Until that occurs caution should be exercised by practitioners and educators to be aware that hypothesis activation occurs early in the nurse-patient contact. The nurse, therefore, should avoid premature closure of the diagnosis and should conduct a thorough information search based on available cues and the nurse's knowledge base and clinical experience.

C. Significance for Nursing

The development of diagnostic skills is important to the development of a profession (Gordon, 1983). The results of this study have implications for both nurse educators and clinical nurses. Information about diagnostic reasoning strategies should be incorporated into nursing curricula. Although nursing students still need to become familiar with guides for systematic data collection (e.g. nursing histories, assessment tools) there is a need for further skill development among nursing students with respect to hypothesis activation. Moreover, methods by which patient cues can be linked to inferences (and, necessarily, cognitive knowledge) and subsequently ruled in or ruled out to confirm or disconfirm a hypothesis need to be developed by nurse educators. Since nurses tend to activate diagnostic hypotheses early in the diagnostic encounter, strategies for paying attention to problems with early hypothesis activation--cue

misinterpretation, excessive data collection, ruling out hypotheses with insufficient information and so forth--need to be developed.

It is suggested that the use of videotaped simulations and thinking aloud is a useful technique to teach diagnostic reasoning strategies to nursing students. Students, with the assistance of nursing instructors, could review videotaped simulations and identify accuracies and errors in their own diagnostic reasoning processes. It is recognized that development of diagnostic reasoning strategies needs to occur concurrently with development of a sound knowledge base in nursing.

Practising clinical nurses should be encouraged to use clinical experiences to develop enhanced diagnostic competence...

> Development of a pattern of practice that regularly involves modifying or strengthening one's diagnostic knowledge by systematically integrating and storing experiences and new knowledge--refurbishing established concepts, building new ones as insights grow, sharpening the precision of the recognitition features and building better connections between related diagnostic concepts.
>
> Carnevali, 1983, 56

The use of videotaped simulations can be incorporated into staff development programs to enhance clinical nurses' diagnostic competence. As Carnevali remarked above, nurses themselves can become their own teachers if they are given a format by which to judge their clinical practice with respect to decision making. It is suggested that the diagnostic reasoning process is such a format.

Finally, the methodology employed in this study provides a rich source of data related to clinical nursing practice. Data analysis techniques can be further developed so that refinement of the diagnostic reasoning process as it related to nursing can occur.

D. Study Limitations

A number of study limitations were identified and are described below. This is a descriptive study, with no comparison group used, therefore no casual inferences can be drawn from the results of this study. Moreover, the study sample used was small and was not randomly selected, therefore, the results are applicable only to the subjects of this study and are not generalizeable to the population of medical-surgical nurses.

As noted in chapter four the possibility of experimenter bias affecting subject response cannot be discounted. Although efforts were made to decrease this effect with the data collector sitting beside the subject, facial expressions and tone of voice may have influenced the subjects' responses. In addition, the data collector may have lead the subjects to pursue a particular line of thinking when information was requested. The writer is aware of a least one instance where this occurred. A subject asked if the patient was on antibiotics and the tester responded that the only medications the patient was receiving were cimetidine and Tylox p.r.n. This provided the subject with more information than she asked for. Finally, variations in subject response (e.g. mood, fatigue level, ease with test procedure) and test procedure (e.g. use of fluorescent lights on overcast days vs. natural lighting) could not be controlled for and may have influenced the subjects' responses.

A number of limitations emerged from the study methodology--videotaped simulation and thinking aloud--employed to stimulate the diagnostic reasoning processes of subjects. As noted in chapter four

use of introspective data may not accurately reflect the thought processes that occur within the subject and the process of thinking aloud may alter the subjects' thought processes. To date, no alternative is known to this writer, which would tap the diagnostic reasoning processes of clinical nurses and avoid the use of introspective data. In addition, as Westfall and associates noted (1985, in press) expert clinicians may rule out simple inferences unconsciously and thus never explicate them. The total number of inferences activated, therefore, may not reflect the total number of inferences generated.

The videotape simulation itself is a representation of an actual clinical situation and to the extent it reflects the reality of the clinical situation for the subjects of the study it will influence the responses generated by the subject. Further to this, the prolonged focus of the video camera on the hearing aids and glasses may have contributed to activation of a greater number of accurate inferences than if less emphasis had been placed on those cues. Although it must be noted that despite the seemingly long emphasis on the hearing aids and glasses, three subjects did not respond to those cues. Finally, only one videotaped simulation was used for data collection, therefore, no intra-individual differences could be identified with respect to diagnostic reasoning strategies.

Coding procedures are open to rater biases. Even though relatively high levels of interrater agreement were established, this does not imply that any pair of rater was necessarily accurate. Further, when training the coder, the writer may have influenced the coder to her way

of thinking which could have influenced the results. The more discussion that took place between raters, the more the raters would tend to think alike, again contributing to possible biases in coding of data.

Additional limitations exist with respect to the study sample. Although efforts were made to ensure that the subjects were expert clinicians, the investigator was dependent on the unit supervisors to apply the criteria for subject selection delineated in chapter four. Given the disparity in examination scores and accurate/plausible hypotheses activation, the sample was not homogenous with respect to these dependent variables. It may be that the two oldest subjects, who were also two of the subjects with English as a second language, did not perform as well as the other subjects, because of inexperience with patient problem delineation and language difficulties. A more homogenous sample with respect to age and language may have produced different results.

The multiple choice examination, as a measure of cognitive knowledge, requires refinement. Internal reliability measures and the content validity assessment suggest that the content with respect to drug knowledge (especially cimetidine) could be enhanced and the number of questions related to diabetes and electrolyte balance could be reduced.

Finally, validity of the accurate diagnoses was not established in the current study since it was beyond the scope of the current study. It was assumed that the accurate diagnoses as identified by Tanner and associates were indeed correct, although that is an area that should be explored in further studies.

E. Suggestions for Further Study

The results of this study point to many areas where further study could be initiated. Increasing the sample size to include comparison groups would allow for more inter-group comparisons. In order to explore Elstein's finding that there does not seem to be intraindividual consistency in diagnostic reasoning, additional videotaped simulations (e.g. those used to train the subjects in the thinking aloud procedure) could be used and results compared within individuals across problem situations.

The area where most study could be directed is in the refinement of the scoring procedures. Scoring procedures used in the current study were rudimentary and reflect the beginning knowledge of diagnostic reasoning in nursing. Tanner and associates are refining scoring procedures to determine comprehensiveness, efficiency and proficiency of inference activation, as well as complexity of inferences activated. Those techniques, when developed, could be employed in a further analysis of the data in the current study. In addition, other components of the diagnostic reasoning model could be studied. For instance, how do nurses rule in or rule out diagnostic inferences?, what are the characteristics of subjects who activate accurate hypotheses versus the characteristics of subjects who activate implausible hypotheses.

Finally, methods of further describing information seeking strategies of subjects e.g. cues used and questions asked, could also be explored. Scoring procedures could be developed so that "irrelevant information introduced by the subject or lengthyinformation seeking could be accounted for". (Tanner, 1977, 198).

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APPENDIX A

University of Alberta

Faculty of Nursing

Informed Consent

As a registered nurse employed in Hospital _____ you have been selected as a prospective subject in the study entitled: "Diagnostic reasoning in clinical nursing: An analysis of cognitive strategies. The study is being conducted by Eileen Thauberger, a master's in nursing candidate at the University of Alberta, Faculty of Nursing.

The purpose of the study is to describe the thought processes used by practitioners in deriving a diagnosis and developing a plan of care. Hopefully the results of this study will help us understand the processes involved in making clinical decisions and will better enable us to teach these processes.

If you consent to participate in this study, you will be asked to participate in two major activities. The first is a series of four clinical simulations which will be administered in one, two hour session. In this activity, you will be presented with patient situations and asked to think out loud as you go through your decision-making process. Your descriptions of your thinking will be tape recorded and transcribed. The second activity is responding to a written, multiple choice examination on adult health and illness nursing which will take approximately one half hour to complete.

You will be assigned a code number known only by Eileen Thauberger. The results will be accessible to and used only by Eileen

Thauberger. All results will be kept strictly anonymous and confidential.

You may refuse to participate in the study and you are free to withdraw your consent and discontinue participation at any time. If you have any questions about the study, you may contact Eileen Thauberger at 476-7196.

Please check:

_____I have read the foregoing and agree to participate in this study.

_____ _____

Signature Date

APPENDIX B

Diagnostic Reasoning in Clinical Nursing:

An Analysis of Cognitive Strategies

Demographic Data

Code Number _____

Please complete the following information. Your anonymity will be assured.

Sex: Female _____ Male _____

Age (at last birthday): Less than 20 years _____

21 - 25 years _____ 26 - 30 years _____

31 - 35 years _____ 36 - 40 years _____

41 - 45 years _____ 46 - 50 years _____

51 years or greater _____

Nursing Education:

1. Basic baccalaureate degree _____ Post-R.N. Baccalaureate degree _____
2. If Post-R.N. Baccalaureate degree, type of diploma program:
   a) Hospital School _____
      Community College _____
      Other (please specify) _____
   b) 2 year program _____
      3 year program _____
      2 + 1 year program _____

3. Country where basic nursing education completed:

   Canada _____ U.S.A. _____ United Kingdom _____

   Other (please specify) _____

4. Please list specialized educational courses taken apart from your basic nursing education (e.g. I.C.U. course):

Clinical Nursing Experience:

1. Number of years of clinical experience (in total):

   2 - 4 years _____

   4 years 1 day - 6 years _____

   6 years 1 day - 8 years _____

   8 years 1 day - 10 years _____

   10 years 1 day - 12 years _____

   12 years 1 day or greater _____

2. If you are a Post-R.N. Baccalaureate, number of years of clinical experience after obtaining your Post-R.N. Baccalaureate Degree:

   2 - 4 years _____

   4 years 1 day - 6 years _____

   6 years 1 day - 8 years _____

   8 years 1 day - 10 years _____

   10 years 1 day - 12 years _____

   12 years 1 day or greater _____

3. Type of clinical unit where currently employed:

   Medical _____ Surgical _____

   Other (please specify) _____

APPENDIX C

Description of Training Simulations (Videotapes)[1]

Simulation #5

Mrs. Anita Hüdlebrandt is a 51 year old woman admitted 14 days ago for excision of recurrent malignant fibrous histiocytoma on her right lateral thigh. She also has a diagnosis of mild hypertension. Wide excision of the tumor was done 12 days ago with deep removal of right upper lateral thigh tissue. She has a Jackson-Pratt drain in place which remains on low constant suction. She has been on solid food since two days post op.

Simulation #6

Mr. Bill Kruzon is a 42 year old man admitted six days ago to the CCU for an anterior myocardial infarction. He has had an uneventful medical course with this first infarction and was transferred to the general medical unit three days ago. He has not reported any pain since his admission and has been aggressive in using his activity program. He is anxious to be discharged and return to his job.

Simulation #8

Mr. Bruce Randall is a 54 year old man who has a 10 year history of chronic obstructive lung disease. He has been on full medical disability for 6 years. Four days ago he went to the local pulmonary clinic because of increasing shortness of breath and dyspnea. This VNA home visit is a follow up from the clinic visit.

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[1]Taken from the case materials provided by Dr. Tanner and associates.

APPENDIX D

Situation 10:

3:00 p.m. Report

Mr. Elmer Seymour is a 70 year old patient admitted three days ago for work-up of abdominal pain. He has diabetes of adult onset, and has a history of alcoholism. He is on NPH insulin 10u. q.a.m. plus regular insulin q.i.d. according to a sliding scale. Yesterday, he spiked a slight fever and developed a coarse, unproductive cough, and was found to have viral pneumonia. He has an I.V. of 1/2 strength normal saline running at 100 cc/hr. He has rested quietly most of the day.

GENERAL HEALTH HISTORY: ON ADMISSION AND CURRENT

Situation 10: Elmer Seymour

Admission

General:
Age: 70 years old
Marital status: Widower
Race: White
Sex: Male
Occupation: retired farmer
Religion: Episcopalian
Birthplace: Maline, Kansas
Source of hx: old chart; retirement centre nurse; self

HPI:

Alcoholism:
Began drinking socially at age 18.
Heavy drinking - 1/5 bourbon every day - began about age 35.
Continuous heavy consumption until hospitalized at age 60 for DM out of control.
Has been "dry" for past 10 years.

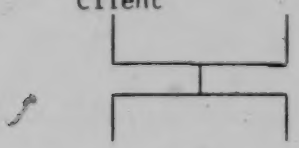
Diabetes Mellitus
AODM - dx at age 42
Controlled by diet for 3 years.
Started on Diabinese 125mg. Q.D. at age 45.
Dosage increased to 100 mg. B.I.D. at age 53.
Admitted to hospital at age 60 for DM out of control. Has been regulated since then on NPH insulin 15 units Qam.

Abdominal Pain
2 weeks PTA: c/o diffuse intermittent pain in lower abdominal region. Relieved by administration of Tylenol.

Current

HPI:

Since admission has been on a soft diet with no food intolerance apparent, although he has been eating very little. Has had one BM since admission.

Admission	Current
1 week PTA: c/o pain more frequent. Now requires use of Tylenol #3 to relieve pain. Exam by physician at that time revealed nothing specific - continues to observe.	Continues to complain of intermittent pain. Patient scheduled for upper G.I. Series in a.m.
Admission: Unable to dx source or adequately treat abdominal pain - admitted for diagnostic workup.	
PMH:	PMH:
General state of health: fair, debilitated by age and disease. Adult Illnesses: alcoholism; DM Psychiatric Illness: none Operations: Hernia repair - age 50 Injuries: broken arm in fall from horse at age 37 Hospitalizations: age 50 - hernia repair. Age 60 - DM out of control Medications: NPH Insulin - 15 units QD Allergies: none	
Habits:	Habits:
Dietary: Regular American Diabetic Association Diet; eats 3 meals/day with snack in p.m. Sleep: gets 9 hours/night.	Dietary: Has dentures; eats very little of ADA diet (soft diet); primarily takes juices and liquids. See diabetic flow sheet for what he ate today. Exercise: none - on bedrest
Exercise: attends class for patients in nursing home twice a week. Caffeine: drinks 2 cups coffee/day Alcohol: none Tobacco: none Other drug: none	Caffeine: 1 cup coffee/day Alcohol: none Tobacco: none
FH:	FH:
Client  46 - 43	

Admission	Current
Health/illnes behaviors: Regular source of health care: physician, retirement centre nurse Compliance level: high Decision maker in family: self	
Psychosocial hx: Lifestyle - sedentary Living arrangement - living in retirement centre Significant others: friends; 2 sons - both live in the area; visit infrequently (1-2x monthly) Typical day - visits with friends, some reading, some TV watching; does own care and light housekeeping; noon meal provided for him in centre, but shops for and fixes own breakfast and evening meal. Involved in recreational activities at centre; takes walks in neighborhood park. Job hx: farmed own land and sold crops for almost 40 years Financial situation: supported by social security and subsidized by sons Education: 10 grade Religious beliefs: leans toward agnosticism Usual coping pattern: unable to deal effectively with stress; usually turned to the bottle for solace.	Psychosocial hx: Typical day - in bed watching TV most of day; has had only one visitor (his son) since admission.
ROS: General: Ht: 5'3" (1.57m) Wt: 140 pounds (63.6kg) Skin: tan, weathered, warm, dry, with some wrinkling - pink Head: full head of white hair Eyes: wears thick glasses; has been wearing corrective lenses since age 51; has very blurred vision without glasses, almost blind (near-sighted) Ears: bilateral hearing aides - has worn since age 60; hears very little without hearing aides	ROS:

Admission	Current
Nose/Sinuses: nostrils patent; subject to frequent colds	
Mouth/Throat: edentulous; gums pink	
Neck: supple, full ROM	
Breasts: symmetrical, no masses	
Respiratory: diminished breath sounds in lower lobes; adventitious sounds heard in upper lobes bilaterally; slight unproductive cough; no c/o of SOB	
Cardiac: normal, S_1, S_2, RRR	
GI: pain in lower abdomen; appetite decreased, uses daily laxative for regulation of bowels	GI: abdomen tender, difficult to palpate due to intense guarding and c/o pain by patient; bowel sounds heard in all 4 quadrants; no abnormal swelling or fluid accumulation; no superficial masses felt
Urinary: has occasional bladder infections; nocturia X1	
Genito-reproductive: circumcised penis; no scrotal masses, prostate slightly enlarged, restricted ROM in lower extremeties; strength decreased bilaterally	
Peripheral vascular: slow capillary refill; pedal pulses absent; lower extremeties cold to touch	
Neurological:	Neurological:
Mental Status: alert, oriented X3	Mental Status: oriented to person only
Cranial nerves: intact	Cranial nerves: intact
Motor/coordination: loss of fine motor coordination	Motor/coordination: unchanged
Reflexes: upper extremities: 2+ lower extremities: 1+	Reflexes: unchanged
Endocrine: has DM	
Hematological: no abnormal bruising or bleeding.	

LABORATORY VALUES

Lab Values Today: 0600 hours

	Traditional Units	S.I. Units		
Glucose	220	12.2	ABG's	
BUN	18	6.4	ph	7.35
Creat	1.4	123.8	pCO_2	43
Na+	140	140		
K+	3.8	3.8	pO_2	75
Cl-	104	104	Bicarb	20
CO_2	30	30		
Uric Acid	7.5	446.1		
Calcium	9	2.25		
Phosphorus	4	1.3		
T. protein	8	80.0		
Albumin	4.5	45.0		
Cholesterol	275	7.1		
T bili	1.2	20.5		
D bili	.3	5.1		
Alk phos	14	14		
LDH	65	65		
SGOT	15	15		
WBC	5,000			
RBC	5.1			
Hgb	15			
Hct	45			
PT	12			
PIT	26			

UA

color	yellow
appear	clear
Sp. gr.	1.012
ph	5
glucose	1+
ketone	trace

DIABETIC FLOW SHEET

Insulin Flow Sheet

Date	Time	Clinitest	Acetest	Reg. Insulin
9/14	0600	trace	neg.	----------
Day 2	1100	1+	-------	----------
	1600	---------	-------	----------
	2100	2+	trace	5U
9/15	0600	1+	trace	----------
Day 3	1100	1+	trace	----------
	1600	neg.	neg.	----------
	2100	neg.	neg.	----------

Sliding Scale

0 - 1+ : 0
2+ : 5U
3+ : 10U
4+ : 15U

Last meal was at 1700 hours. He ate 1/2 of his main course and drank all of the beverages.

MEDICATION RECORD

Mr. Elmer Seymour

MEDICATION	DATE Admission	DATE Day 2	DATE Day 3
Cimetidine		0600	0600
300 mg I.V. q.8h.	1400	1400	1400
	2200	2200	2200
NPH insulin			
10 U subQ q.a.m.		0600	0600

GRAPHIC SHEET

Mr. Elmer Seymour

	Time	Admission	Day 1	Day 2	Day 3
	0200	36°	36^{8}	37^{2}	-
T	0600	36^{8}	-	-	37°
E	1000	36^{6}	36^{9}	37^{8}	-
M	1400	-	-	37^{9}	-
P	1800	36^{6}	36^{6}	-	37^{1}
	2400	-	-	36^{9}	
P	0200	112	82	108	84
U	0600	116	-	-	-
L	1000	94	96	80^{R}	88^{R}
S	1800	80	80^{R}	90	88^{R}
E					
	R = radial, all other apical				
R	0200	24	18	24	16
E	0600	24	-	-	-
S	1000	22	-	-	20
P	1800	24	24	20	20
B.P.	0015	138/74	142/68	142/88	130/160
	0400	134/92	-	-	-
	0800	140/82	130/90	136/80	120/78
	1700	136/80	134/88	142/60	-
Weight (kg)				62.3	61.8

APPENDIX E

Prompting Questions

After report and after videotape:

1. What are you thinking about now that you have heard the report (seen the videotape)?

2. (Follow-up question, if needed.) What meaning(s) do you attach to the information?

3. What additional information do you want?

4. What would this information mean to you? (Ask before giving information.)

5. How has that information helped you? (Ask after information given.)

6. Would you please summarize your conclusions from all the information about this particular situation. (Ask after subject has indicated she/he is finished gathering information.)

7. What nursing action or actions would you take in this situation?

8. Why are you taking the action or actions for this specific patient?

9. (If doctor is to be called, ask the following questions:)

   a. Why would you call a doctor?

   b. What would you tell the doctor?

   c. What actions would you expect the doctor to take?

APPENDIX 'F

Written Examination

Please read the following questions carefully and mark the correct answers directly on the examination.

I. COMMON PROBLEMS IN HOSPITAL PATIENTS

Rest is necessary for the body to repair itself. However, patients confined to bed with too little exercise are prone to develop several untoward effects. For each problem listed below (1-12), mark (A) if the problem may result from prolonged immobility; (B) if it does not result from immobility.

1. Decubitus ulcer _____
2. Arthritis _____
3. Lethargy _____
4. Pneumonia _____
5. Muscle weakness _____
6. Contractures _____
7. Reduced blood return to heart _____
8. Fluid retention _____
9. Anger _____
10. Insomnia _____
11. Protein anabolism _____
12. Bone demineralization. _____

13. A patient's perception of pain severity may be increased by the following:

    1. Analgesics
    2. Circulatory stasis
    3. Anxiety
    4. Distraction
    5. Desire to void.

    a. 1, 2, 3
    b. 1, 3, 4
    c. 2, 3, 4
    d. 2, 3, 5
    e. 3, 4, 5

14. The pain threshold may be lowered by:

    1. Persistent pain
    2. Warmth
    3. Alcohol consumption
    4. Physical weakness
    5. Anger

    a. 1, 3, 4
    b. 1, 4, 5
    c. 2, 3, 4
    d. 2, 3, 5
    e. 3, 4, 5

ITEMS 15 THROUGH 19 ARE MATCHING

Match the following causes with the most appropriate electrolyte imbalance. **ANSWERS MAY BE USED ONLY ONCE.**

CAUSE		ELECTROLYTE IMBALANCE
15. Acute pancreatitis	___	A. Hyperphosphatemia
16. Chronic alcoholism	___	B. Hypercalcemia
17. Oliguria	___	C. Hyponatremia
18. Prolonged immobility	___	D. Hyperkalemia
19. Potent diuretic therapy	___	E. Hypomagnesemia

20. Extracellular fluid volume excess can be manifested by all of the following **EXCEPT**

a. Shortness of breath
b. Edema
c. Weight gain
d. Decreased blood pressure
e. Confusion

21. Signs and symptoms of anemia include:

1. Pallor
2. Shortness of breath
3. Fatigue
4. Increased temperature

a. 1 only
b. 1 and 3
c. 1, 2, 3
d. 2 and 3
e. All of the above.

22. Restlessness is a common occurrence in hospitalized patients. All of the following are common causes of restlessness **EXCEPT:**

a. Urinary retention
b. Hypokalemia
c. Pain
d. Cerebral anoxia
e. Intestinal distention.

23. Which of the following are normal changes in vision in the aging process?

1. Acuity decreased
2. Visual fields decreased
3. Decrease in the minimal threshold for light perception perception
4. Change in color perception
5. Decreased ability to see size, distance and position of objects at a distance.

a. All of the above
b. 1, 3, 5
c. 2, 3, 4
d. 1, 2, 4, 5.

24. Confusion is a common sign occurring in hospitalized patients. Which of the following are common causes of confusion in the hospitalized elderly?

a. Impairment of sight and hearing
b. Untoward effects of medication
c. Altered environmental stimuli
d. Two of the above
e. All of the above

25. Of the following patients, the one who is most likely to suffer from sensory deprivation is the patient who has had:

a. Chest surgery and is in a four-bed room
b. Orthopedic surgery and is in traction
c. Eye surgery and is in a semi-private room
d. Heart surgery and is in an I.C.U.

26. Of the following phrases, which one best describes the typical onset of a chronic organic brain disorder?

a. Abrupt, with no forewarning
b. Rapid, with many precursory signs
c. Slow, with obvious symptomatology
d. Gradual, with lucid intervals interspersed throughout.

27. Ms. Baxter, a 44 year old homemaker, entered the hospital for treatment of cirrhosis of the liver. She has a seven year history of drinking a six pack of beer and some wine every day. Ms. Baxter receives the appropriate medical and nursing treatment for her liver disorder and her condition improves slightly. However, after five days in the hospital, she begins to thrash about in bed, hitting the sheets and yelling, "Go away, bugs, go away!" Several times she was overheard asking, "What, did you say?" when alone in her room. Which one of the following nursing notes best sums up Ms. Baxter's behavior?

a. Restless and disorienting; hallucinating
b. Agitated; having auditory and visual hallucinations
c. Fidgety; out of contact with reality; overheard talking to herself in room
d. Seeing "bugs" in her bedclothes and slapping at them; responding to unseen voices with "What?".

28. In relation to untreated alcoholism, which one of the following conditions best describes the type of mental disturbance the person who chronically abuses alcohol is most likely to develop in the future?

a. Alcoholic stupor
b. Organic brain disorder
c. Pathologic intoxication
d. Alcoholic hallucinosis.

Mr. H. is a 68 year old man with insulin-dependent diabetes. He is on a 2000 calorie ADA diet and takes Lente insulin 20 units every morning. He is currently hospitalized for a hernia repair. In caring for Mr. H, the nurse should know which factors influence exogenous insulin requirements in the diabetic. For items 29 through 33, indicate if the factor:

A. increases insulin requirements
B. decreases insulin requirements
C. has no effect on insulin requirements.

29. Illness_____
30. Exercise_____
31. Surgery _____
32. Malabsorption_____
33. Increased intake of fat_____

34. If Mr. H receives his Lente insulin at 7:00 a.m., when is his blood sugar likely to be lowest?

a. 1200 hours
b. 1700 hours
c. 2100 hours
d. 2400 hours

Mr. H should be observed for signs of both hypoglycemia and hyperglycemia. For each sign listed in items 35 to 40 indicate if it is associated with:

A. hypoglycemia
B. hyperglycemia;
C. both hypo- and hyperglycemia
D. neither hypo- nor hyperglycemia.

35. Profuse diaphoresis_____
36. Warm, dry skin_____
37. Fruity breath_____
38. Increased appetite_____
39. Sudden change in behavior_____
40. Tachycardia_____

41. Of the following manifestations of hypoxia, which one is usually "later-appearing"?

a. Anxiety
b. Cyanosis
c. Fatigue
d. Headache
e. Tachycardia

APPENDIX G

TABLE OF SPECIFICATIONS
Case 10

	Etiology N	Items []*	S & Sx Complications N	Items	Treatment N	Items
Pneumonia	(1)	27 [4]	(1)	92		
Pain	(1)	44 [13]	(2)	46,47 [14]	(1)	45
Electrolyte imbalance			(1)	5, 52-57 [15-20]		
Confusion/restlessness	(2)	62,71 [22,22]				
Hypoxemia			(2)	74-115 [41]		
Anemia			(1)	60 [21]		
Aging			(2)	69,70 [23]		
Organic Brain Syndrome			(1)	90 [26]	(1)	89
Sensory Deprivation	(1)	72 [25]	(2)	73,74		
Alcoholism			(2)	94,95 [27,28]		
Drugs	**Action**		**Signs & Symptoms of SE or Toxic Effects**			
Insulin	(1)	96-101[29,31, 32,34]	(1)	102-107 [35-40]		
Cimetidine			(1)	117		

* [ ] = item number in current study

APPENDIX H

SIMULATION 10

CUE - HYPOTHESIS MATRIX

VIDEOTAPED SIMULATION

	Relevant Cues	Accurate Diagnosis	Diagnostic Hypothesis
	T.V. going Night Patient Rambling	1. Sensory deprivation related to physical impairment.	Hypoxemia related to pneumonia and/or immobility and/or anemia Hypoglycemia/Hyperglycemia
Tape	Calling Nurse Elsie Doesn't respond to nurse's attempt to orient Glasses and hearing aid on stand I.V. with Added Medication	2. Sundowner's,* side effect of 3. Cimetidine, side effect.	DT's Fever Unusual behavior Electrolyte Imbalance Dehydration Pain Liver Dysfunction
	70 years old Admitted 3 days ago AODM (Adult On-Set Diabetes Mellitus) History of Alcoholism Abdominal Pain		
Report	NPH Insulin-10u every morning Regular insulin - sliding scale Developed fever yesterday Coarse unproductive cough Viral Pneumonia I.V. - 1/2 Normal Saline Rested quietly today		

*Sundowner's is not a term familiar to Edmonton nurses. For the purposes of this study the phrase "disorientation related to new environment and time of day" was used for the term Sundowner's. It is recognized that the substituted phrase does not capture all the nuances of the term "Sundowner's".

APPENDIX I

This is an experiment to find out how clinical nurses think when identifying what's wrong with a patient that requires nursing intervention. In order to accomplish this goal, a simulated nursing report and a videotaped simulation of a patient encounter have been developed. The nurse subjects will view this videotape, after hearing the simulated nursing report, and will be asked to seek information (e.g. lab results; physical exam information) from the examinee as they would in the actual patient situation. In addition, the nurse subjects will be asked to think aloud, describing their reasoning as they seek the information available. At the conclusion of the diagnostic reasoning process, the subjects will be asked to summarize all identified patient problems. The thinking aloud protocols will be tape-recorded and transcribed. The transcribed verbal protocols will be subjected to content analysis.

Because of your expertise as a medical-surgical clinical nurse or nurse educator, you have been asked to rate the simulated nursing report and videotaped simulation along a number of dimensions.

Nursing Report

The nursing report is traditionally used in most hospitals as a change-of-shift report. As a nurse you expect the report to be concise, yet to convey enough information about the patient, at the time the report is given, to enable you to start an assessment of the patient. Please rate this nursing report along the dimensions given, using the rating scale 1 to 7. A 1 indicates the maximum amount of the dimension measured, while a 7 indicates the minimum amount. The in-between numbers correspond to all likelihoods in between minimum and maximum. A 4 is 50-50.

1. The nursing report used terminology which is understandable to me.

1	2	3	4	5	6	7
very understandable						not at all understandable

2. The nursing report is typical of the kind of report I would receive on a medical-surgical unit of a general hospital at change-of-shift.

1	2	3	4	5	6	7
very typical						not at all typical

3. This nursing report contains enough information so that I could begin a patient assessment.

1	2	3	4	5	6	7
sufficient information						no information

4. The nursing report is relevant to a clinical nurse on a general medical-surgical nursing unit.

1	2	3	4	5	6	7
very relevant						not at all relevant

Please list the cues you noted in the nursing report in front of you. A cue is a unit of information you as a nurse would note about the patient and/or his environment (e.g. lab data, physical exam data, physical responses, etc.).

Please list the cues you noted in the videotaped simulation you just saw. A cue is a unit of information you as a nurse would note about the patient and/or his environment (e.g. lab data, physical exam data, patient responses, etc.).

Videotaped Simulation

Because of the difficulty assuring uniformity of information in using actual nurse-patient encounters, a videotaped simulation was developed to assess the ability of clinical nurses in identifying patient problems amenable to nursing intervention. Again please rate the videotaped simulation along the dimensions given using a rating scale of 1 to 7. A "1" indicates the maximum amount of the dimension measured, while a "7" indicates the minimum amount. The in-between numbers correspond to all likelihoods in between minimum and maximum. A "4" is 50-50.

1. The videotaped simulation depicts a patient situation which a clinical nurse is likely to encounter on a medical-surgical nursing unit.

1	2	3	4	5	6	7
very likely						not at all likely

2. The videotaped simulation is realistic.

1	2	3	4	5	6	7
very realistic						not at all realistic

3. The videotaped simulation depicts the kinds of cues a clinical nurse would typically see in a 70 year old apparently confused gentleman.

1	2	3	4	5	6	7
very typical cues						not at all typical cues

4. The videotaped simulation holds my attention.

1	2	3	4	5	6	7
very interesting						very boring

5. The cues depicted in the simulation are typical of information nurses usually have for selecting information.

1	2	3	4	5	6	7
very typical information						not at all typical information

Please note any additional comments about the simulated nursing report and/or the simulated videotaped patient simulation.

APPENDIX J

DIAGNOSTIC REASONING IN CLINICAL NURSING

This is a study to find out how clinical nurses think when identifying what is wrong with a patient that requires nursing intervention. In order to accomplish this task, a simulated nursing report and videotaped patient simulation will be used as the stimulus materials to elicit the diagnostic reasoning processes of the subjects. That is the subjects will listen to the nursing report and will watch the videotaped patient simulation. They will then be asked to identify the nursing diagnoses (patient problems) applicable to the simulation by seeking information from the examiner. The examiner has available a variety of data (e.g. lab reports, medication data, vital signs data, physical exam data, etc.) which relates to the simulation. Subjects will be asked to think aloud as they seek information from the examiner and to describe their reasoning as they seek this information. There are 3 possible diagnoses that can be made after the subjects have completed their diagnostic workup.

Because of your expertise as a medical-surgical clinical nurse or a nurse educator, you have been asked to rate selected cues, taken from the simulated materials, with respect to those cues' relevance and importance to the 3 diagnoses applicable to the simulation are:

1. Sensory deprivation related to diminished sight and hearing

2. Confusion related to new environment and time of day

3. Side effect of cimetidine (Tagamet)

A description of the task follows on the next page.

Rater (Please Complete):

1. Current Employment: _____ Educator _____ Clinical Nurse

2. Number of years of nursing experience (total): _____

RELEVANCE

This is a task to find out the relevance of certain cues to a given diagnosis. For example, suppose you were a nurse caring for Mr. Jones who had a potential decubitus ulcer on his hip. If I asked you to tell me what cues you noted in Mr. Jones or in his environment that lead you to determine he had a potential decubitus ulcer you might say he had reddened skin, he was bedridden, he was poorly nourished, he slept on an alternating pressure mattress, and so on.

Now let's suppose I asked you how relevant the various cues you noted were to the diagnosis of potential decubitus ulcer. You would probably say reddened skin is very relevant to the diagnosis because it's always associated with decubitus ulcer. Similarly prolonged immobility is very relevant to the diagnosis of potential decubitus ulcer because it, too, is always associated with that diagnosis. On the other hand, elevated temperature is probably not very relevant to the diagnosis of potential decubitus ulcer because a person can have an elevated temperature without a decubitus ulcer or alternately a person can have a decubitus ulcer and be afebrile. Poor protein intake might fall somewhere in the middle between prolonged immobility and elevated temperature with respect to relevance. It may also be relevant to the diagnosis of potential decubitus ulcer that Mr. Jones sleeps on an alternating pressure mattress because that could minimize the chances of his developing an actual decubitus ulcer. Let's say you were to rate these cues on a 7 point scale with respect to relevance to the diagnosis of potential decubitus ulcer, with 7 being very relevant and 1 being not very relevant. You might rate reddness of skin as a 7, alternating pressure mattress a 6, poor protein intake a 4 and elevated temperature a 1.

Your task is to make decisions about the relevance of various cues to each of the 3 diagnoses described in the introduction. I have listed a number of cues on the following pages. These cues were taken from the videotaped simulation, nursing report and accompanying patient information (e.g. lab data, medication info., physical exam data, etc.) described in the introduction. Next to each cue are the numbers 1 to 7. Circle a "1" if the cue is <u>not very</u> relevant to the given diagnosis and a "7" if the cue is <u>very</u> relevant to the given diagnosis. Use the in between numbers to correspond to all likelihoods in between not very relevant and very relevant. A "4" is 50-50 with respect to relevance.

Nursing Diagnosis: SENSORY DEPRIVATION RELATED TO DIMINISHED SIGHT AND HEARING

Please rate each of the following cues, using the 7 point scale described on the previous page, with respect to that cue's relevance to the diagnosis noted above. Think of relevance as information that is important to the stated diagnosis because it either rules in or rules out that diagnosis. Remember all the cues listed refer to either the simulated patient (described in the introduction) and/or his environment. Circle the number you think best fits each cue.

CUE	NOT VERY RELEVANT						VERY RELEVANT
1. Person in white lab coat	1	2	3	4	5	6	7
2. Patient talking aloud to himself	1	2	3	4	5	6	7
3. Dimly lit hallway	1	2	3	4	5	6	7
4. No alcohol for 10 years	1	2	3	4	5	6	7
5. Adult onset diabetes for 30 years	1	2	3	4	5	6	7
6. Patient has viral pneumonia	1	2	3	4	5	6	7
7. Patient eyeglasses on overbed table	1	2	3	4	5	6	7
8. Patient calls male nurse "Elsie"	1	2	3	4	5	6	7
9. Sleeps 7 hours/night	1	2	3	4	5	6	7
10. Usual residence: retirement centre	1	2	3	4	5	6	7
11. Patient 70 years old	1	2	3	4	5	6	7
12. Lights on above patient bed	1	2	3	4	5	6	7
13. T.V. playing in patient room	1	2	3	4	5	6	7
14. Nearsighted without glasses	1	2	3	4	5	6	7
15. Diminished breath sounds lower lobes	1	2	3	4	5	6	7
16. Bowel sounds head in all 4 quadrants	1	2	3	4	5	6	7
17. Oriented to person only	1	2	3	4	5	6	7
18. Medication tray placed on overbed table	1	2	3	4	5	6	7

CUE	NOT VERY RELEVANT						VERY RELEVANT
19. Night time	1	2	3	4	5	6	7
20. Patient room painted white/orange	1	2	3	4	5	6	7
21. Blood glucose: 12.2 S.I. units	1	2	3	4	5	6	7
22. I.V. with added medication	1	2	3	4	5	6	7
23. Blood pH: 7.35	1	2	3	4	5	6	7
24. Patient does not respond to nurse's attempt to orient	1	2	3	4	5	6	7
25. B.P. 120/78	1	2	3	4	5	6	7
26. Spiked a slight fever	1	2	3	4	5	6	7
27. Hospitalized 3 days	1	2	3	4	5	6	7
28. Hernia repair 20 years ago	1	2	3	4	5	6	7
29. Drinks 1 cup coffee/day	1	2	3	4	5	6	7
30. On Cimetidine 300 mg. I.V. q. 8h.	1	2	3	4	5	6	7
31. Temperature 37.1°C.	1	2	3	4	5	6	7
32. Clinitest: negative/negative	1	2	3	4	5	6	7
33. Patient hearing aids on overbed table.	1	2	3	4	5	6	7
34. Hgb. 15 gms/100ml.	1	2	3	4	5	6	7
35. W.B.C. 5000	1	2	3	4	5	6	7
36. Serum potassium: 3.8	1	2	3	4	5	6	7
37. On insulin 15 units q. a.m.	1	2	3	4	5	6	7
38. Retired farmer	1	2	3	4	5	6	7
39. Complains of diffuse, intermittent abdominal pain	1	2	3	4	5	6	7
40. Typical hospital day spent watching T.V. in bed	1	2	3	4	5	6	7

Nursing Diagnosis: CONFUSION RELATED TO NEW ENVIRONMENT AND TIME OF DAY

Please rate each of the following cues, using the 7 point scale described on the previous page, with respect to that cue's relevance to the diagnosis noted above. Think of relevance as information that is important to the stated diagnosis because it either rules in or rules out that diagnosis. Remember all the cues listed refer to either the simulated patient (described in the introduction) and/or his environment. Circle the number you think best fits each cue.

CUE	NOT VERY RELEVANT						VERY RELEVANT
1. Person in white lab coat	1	2	3	4	5	6	7
2. Patient talking aloud to himself	1	2	3	4	5	6	7
3. Dimly lit hallway	1	2	3	4	5	6	7
4. No alcohol for 10 years	1	2	3	4	5	6	7
5. Adult onset diabetes for 30 years	1	2	3	4	5	6	7
6. Patient has viral pneumonia	1	2	3	4	5	6	7
7. Patient eyeglasses on overbed table	1	2	3	4	5	6	7
8. Patient calls male nurse "Elsie"	1	2	3	4	5	6	7
9. Sleeps 7 hours/night	1	2	3	4	5	6	7
10. Usual residence: retirement centre	1	2	3	4	5	6	7
11. Patient 70 years old	1	2	3	4	5	6	7
12. Lights on above patient bed	1	2	3	4	5	6	7
13. T.V. playing in patient room	1	2	3	4	5	6	7
14. Nearsighted without glasses	1	2	3	4	5	6	7
15. Diminished breath sounds lower lobes	1	2	3	4	5	6	7
16. Bowel sounds head in all 4 quadrants	1	2	3	4	5	6	7
17. Oriented to person only	1	2	3	4	5	6	7
18. Medication tray placed on overbed table	1	2	3	4	5	6	7

Page 2

CUE	NOT VERY RELEVANT						VERY RELEVANT
19. Night time	1	2	3	4	5	6	7
20. Patient room painted white/orange	1	2	3	4	5	6	7
21. Blood glucose: 12.2 S.I. units	1	2	3	4	5	6	7
22. I.V. with added medication	1	2	3	4	5	6	7
23. Blood pH: 7.35	1	2	3	4	5	6	7
24. Patient does not respond to nurse's attempt to orient	1	2	3	4	5	6	7
25. B.P. 120/78	1	2	3	4	5	6	7
26. Spiked a slight fever	1	2	3	4	5	6	7
27. Hospitalized 3 days	1	2	3	4	5	6	7
28. Hernia repair 20 years ago	1	2	3	4	5	6	7
29. Drinks 1 cup coffee/day	1	2	3	4	5	6	7
30. On Cimetidine 300 mg. I.V. q. 8h.	1	2	3	4	5	6	7
31. Temperature 37.1°C.	1	2	3	4	5	6	7
32. Clinitest: negative/negative	1	2	3	4	5	6	7
33. Patient hearing aids on overbed table.	1	2	3	4	5	6	7
34. Hgb. 15 gms/100ml.	1	2	3	4	5	6	7
35. W.B.C. 5000	1	2	3	4	5	6	7
36. Serum potassium: 3.8	1	2	3	4	5	6	7
37. On insulin 15 units q. a.m.	1	2	3	4	5	6	7
38. Retired farmer	1	2	3	4	5	6	7
39. Complains of diffuse, intermittent abdominal pain	1	2	3	4	5	6	7
40. Typical hospital day spent watching T.V. in bed	1	2	3	4	5	6	7

Nursing Diagnosis: SIDE EFFECT OF CIMETIDINE (TAGAMET)

Please rate each of the following cues, using the 7 point scale describe on the previous page, with respect to that cue's relevance to the diagnosis noted above. Think of relevance as information that is important to the stated diagnosis because it either rules in or rules ou that diagnosis. Remember all the cues listed refer to either the simulated patient (described in the introduction) and/or his environment. Circle the number you think best fits each cue.

CUE	NOT VERY RELEVANT						VERY RELEVANT
1. Person in white lab coat	1	2	3	4	5	6	7
2. Patient talking aloud to himself	1	2	3	4	5	6	7
3. Dimly lit hallway	1	2	3	4	5	6	7
4. No alcohol for 10 years	1	2	3	4	5	6	7
5. Adult onset diabetes for 30 years	1	2	3	4	5	6	7
6. Patient has viral pneumonia	1	2	3	4	5	6	7
7. Patient eyeglasses on overbed table	1	2	3	4	5	6	7
8. Patient calls male nurse "Elsie"	1	2	3	4	5	6	7
9. Sleeps 7 hours/night	1	2	3	4	5	6	7
10. Usual residence: retirement centre	1	2	3	4	5	6	7
11. Patient 70 years old	1	2	3	4	5	6	7
12. Lights on above patient bed	1	2	3	4	5	6	7
13. T.V. playing in patient room	1	2	3	4	5	6	7
14. Nearsighted without glasses	1	2	3	4	5	6	7
15. Diminished breath sounds lower lobes	1	2	3	4	5	6	7
16. Bowel sounds head in all 4 quadrants	1	2	3	4	5	6	7
17. Oriented to person only	1	2	3	4	5	6	7
18. Medication tray placed on overbed table	1	2	3	4	5	6	7

CUE	NOT VERY RELEVANT						VERY RELEVANT
19. Night time	1	2	3	4	5	6	7
20. Patient room painted white/orange	1	2	3	4	5	6	7
21. Blood glucose: 12.2 S.I. units	1	2	3	4	5	6	7
22. I.V. with added medication	1	2	3	4	5	6	7
23. Blood pH: 7.35	1	2	3	4	5	6	7
24. Patient does not respond to nurse's attempt to orient	1	2	3	4	5	6	7
25. B.P. 120/78	1	2	3	4	5	6	7
26. Spiked a slight fever	1	2	3	4	5	6	7
27. Hospitalized 3 days	1	2	3	4	5	6	7
28. Hernia repair 20 years ago	1	2	3	4	5	6	7
29. Drinks 1 cup coffee/day	1	2	3	4	5	6	7
30. On Cimetidine 300 mg. I.V. q. 8h.	1	2	3	4	5	6	7
31. Temperature 37.1°C.	1	2	3	4	5	6	7
32. Clinitest: negative/negative	1	2	3	4	5	6	7
33. Patient hearing aids on overbed table.	1	2	3	4	5	6	7
34. Hgb. 15 gms/100ml.	1	2	3	4	5	6	7
35. W.B.C. 5000	1	2	3	4	5	6	7
36. Serum potassium: 3.8	1	2	3	4	5	6	7
37. On insulin 15 units q. a.m.	1	2	3	4	5	6	7
38. Retired farmer	1	2	3	4	5	6	7
39. Complains of diffuse, intermittent abdominal pain	1	2	3	4	5	6	7
40. Typical hospital day spent watching T.V. in bed	1	2	3	4	5	6	7

IMPORTANCE

This is a task to find out how important certain cues are to identifying a given diagnosis. Suppose you were a nurse caring for Mrs. Smith who you diagnosed as having a grief reaction, related to the recent death of her son. If I asked you to tell me what cues you noted in Mrs. Smith or in her environment that lead you to make the diagnosis grief reaction, related to recent death of her son, you might say Mrs. Smith cries inconsolably at the mention of her son, she withdraws from contact with others, her son died two weeks ago, her eating habits have changed and so on.

Now let's suppose I asked you how important various cues were to the diagnosis grief reaction, related to recent death of her son. You might say crying inconsolably is relatively important because it's very often associated with grief reaction. Similarly altered eating habits is relatively important to the diagnosis because it, too, is very often associated with grief reaction. Mrs. Smith's son's death two weeks ago is very important to the diagnosis because it's a necessary pre-requisite to the diagnosis grief reaction. The cue that Mrs. Smith's sleeping patterns have not changed from her normal patterns is not an important cue because it is not an essential cue nor does it confirm the diagnosis grief reaction, related to recent death of son. Let's say you were to rate these cues on a 7 point scale with respect to importance to the diagnosis of grief reaction, with 7 being very important and 1 being not very important. You might rate son's death 2 weeks ago a "7", crying inconsolably a "6", altered eating habits a "6", and unchanged sleeping patterns a "1".

Your task is to make decisions about the importance of various cues to each of the 3 diagnoses described in the introduction. I have listed a number of cues on the following pages. These cues were taken from the videotaped simulation, nursing report and accompanying patient information (e.g. lab data, medication info., physical exam data, etc.) described in the introduction. Next to each cue are the numbers 1 to 7. Circle a "1" if the cue is <u>not very</u> important to the given diagnosis and a "7" if the cue is <u>very</u> important to the given diagnosis. Use the in between numbers to correspond to all likelihoods in between not very important and very important. A "4" is 50-50 with respect to importance.

Nursing Diagnosis: SENSORY DEPRIVATION RELATED TO DIMINISHED SIGHT AND HEARING

Please rate each of the following cues, using the 7 point scale described on the previous page, with respect to that cue's relevance to the diagnosis noted above. Think of importance as those critical characteristics or pieces of information that must be present in order for you to say the patient has the stated diagnosis. Remember all the cues listed refer to either the simulated patient (described in the introduction) and/or his environment. Circle the number you think best fits each cue.

CUE	NOT VERY IMPORTANT						VERY IMPORTANT
1. Person in white lab coat	1	2	3	4	5	6	7
2. Patient talking aloud to himself	1	2	3	4	5	6	7
3. Dimly lit hallway	1	2	3	4	5	6	7
4. No alcohol for 10 years	1	2	3	4	5	6	7
5. Adult onset diabetes for 30 years	1	2	3	4	5	6	7
6. Patient has viral pneumonia	1	2	3	4	5	6	7
7. Patient eyeglasses on overbed table	1	2	3	4	5	6	7
8. Patient calls male nurse "Elsie"	1	2	3	4	5	6	7
9. Sleeps 7 hours/night	1	2	3	4	5	6	7
10. Usual residence: retirement centre	1	2	3	4	5	6	7
11. Patient 70 years old	1	2	3	4	5	6	7
12. Lights on above patient bed	1	2	3	4	5	6	7
13. T.V. playing in patient room	1	2	3	4	5	6	7
14. Nearsighted without glasses	1	2	3	4	5	6	7
15. Diminished breath sounds lower lobes	1	2	3	4	5	6	7
16. Bowel sounds head in all 4 quadrants	1	2	3	4	5	6	7
17. Oriented to person only	1	2	3	4	5	6	7
18. Medication tray placed on overbed table	1	2	3	4	5	6	7

Page 2

CUE	NOT VERY IMPORTANT						VERY IMPORTANT
19. Night time	1	2	3	4	5	6	7
20. Patient room painted white/orange	1	2	3	4	5	6	7
21. Blood glucose: 12.2 S.I. units	1	2	3	4	5	6	7
22. I.V. with added medication	1	2	3	4	5	6	7
23. Blood pH: 7.35	1	2	3	4	5	6	7
24. Patient does not respond to nurse's attempt to orient	1	2	3	4	5	6	7
25. B.P. 120/78	1	2	3	4	5	6	7
26. Spiked a slight fever	1	2	3	4	5	6	7
27. Hospitalized 3 days	1	2	3	4	5	6	7
28. Hernia repair 20 years ago	1	2	3	4	5	6	7
29. Drinks 1 cup coffee/day	1	2	3	4	5	6	7
30. On Cimetidine 300 mg. I.V. q. 8h.	1	2	3	4	5	6	7
31. Temperature 37.1°C.	1	2	3	4	5	6	7
32. Clinitest: negative/negative	1	2	3	4	5	6	7
33. Patient hearing aids on overbed table.	1	2	3	4	5	6	7
34. Hgb. 15 gms/100ml.	1	2	3	4	5	6	7
35. W.B.C. 5000	1	2	3	4	5	6	7
36. Serum potassium: 3.8	1	2	3	4	5	6	7
37. On insulin 15 units q. a.m.	1	2	3	4	5	6	7
38. Retired farmer	1	2	3	4	5	6	7
39. Complains of diffuse, intermittent abdominal pain	1	2	3	4	5	6	7
40. Typical hospital day spent watching T.V. in bed	1	2	3	4	5	6	7

Nursing Diagnosis: CONFUSION RELATED TO NEW ENVIRONMENT AND TIME OF DAY

Please rate each of the following cues, using the 7 point scale described on the previous page, with respect to that cue's relevance to the diagnosis noted above. Think of importance as those critical characteristics or pieces of information that must be present in order for you to say the patient has the stated diagnosis. Remember all the cues listed refer to either the simulated patient (described in the introduction) and/or his environment. Circle the number you think best fits each cue.

CUE	NOT VERY IMPORTANT						VERY IMPORTANT
1. Person in white lab coat	1	2	3	4	5	6	7
2. Patient talking aloud to himself	1	2	3	4	5	6	7
3. Dimly lit hallway	1	2	3	4	5	6	7
4. No alcohol for 10 years	1	2	3	4	5	6	7
5. Adult onset diabetes for 30 years	1	2	3	4	5	6	7
6. Patient has viral pneumonia	1	2	3	4	5	6	7
7. Patient eyeglasses on overbed table	1	2	3	4	5	6	7
8. Patient calls male nurse "Elsie"	1	2	3	4	5	6	7
9. Sleeps 7 hours/night	1	2	3	4	5	6	7
10. Usual residence: retirement centre	1	2	3	4	5	6	7
11. Patient 70 years old	1	2	3	4	5	6	7
12. Lights on above patient bed	1	2	3	4	5	6	7
13. T.V. playing in patient room	1	2	3	4	5	6	7
14. Nearsighted without glasses	1	2	3	4	5	6	7
15. Diminished breath sounds lower lobes	1	2	3	4	5	6	7
16. Bowel sounds head in all 4 quadrants	1	2	3	4	5	6	7
17. Oriented to person only	1	2	3	4	5	6	7
18. Medication tray placed on overbed table	1	2	3	4	5	6	7

CUE	NOT VERY IMPORTANT						VERY IMPORTANT
19. Night time	1	2	3	4	5	6	7
20. Patient room painted white/orange	1	2	3	4	5	6	7
21. Blood glucose: 12.2 S.I. units	1	2	3	4	5	6	7
22. I.V. with added medication	1	2	3	4	5	6	7
23. Blood pH: 7.35	1	2	3	4	5	6	7
24. Patient does not respond to nurse's attempt to orient	1	2	3	4	5	6	7
25. B.P. 120/78	1	2	3	4	5	6	7
26. Spiked a slight fever	1	2	3	4	5	6	7
27. Hospitalized 3 days	1	2	3	4	5	6	7
28. Hernia repair 20 years ago	1	2	3	4	5	6	7
29. Drinks 1 cup coffee/day	1	2	3	4	5	6	7
30. On Cimetidine 300 mg. I.V. q. 8h.	1	2	3	4	5	6	7
31. Temperature 37.1°C.	1	2	3	4	5	6	7
32. Clinitest: negative/negative	1	2	3	4	5	6	7
33. Patient hearing aids on overbed table.	1	2	3	4	5	6	7
34. Hgb. 15 gms/100ml.	1	2	3	4	5	6	7
35. W.B.C. 5000	1	2	3	4	5	6	7
36. Serum potassium: 3.8	1	2	3	4	5	6	7
37. On insulin 15 units q. a.m.	1	2	3	4	5	6	7
38. Retired farmer	1	2	3	4	5	6	7
39. Complains of diffuse, intermittent abdominal pain	1	2	3	4	5	6	7
40. Typical hospital day spent watching T.V. in bed	1	2	3	4	5	6	7

Nursing Diagnosis: SIDE EFFECT OF CIMETIDINE (TAGAMET)

Please rate each of the following cues, using the 7 point scale described on the previous page, with respect to that cue's relevance to the diagnosis noted above. Think of importance as those critical characteristics or pieces of information that must be present in order for you to say the patient has the stated diagnosis. Remember all the cues listed refer to either the simulated patient (described in the introduction) and/or his environment. Circle the number you think best fits each cue.

CUE	NOT VERY IMPORTANT						VERY IMPORTANT
1. Person in white lab coat	1	2	3	4	5	6	7
2. Patient talking aloud to himself	1	2	3	4	5	6	7
3. Dimly lit hallway	1	2	3	4	5	6	7
4. No alcohol for 10 years	1	2	3	4	5	6	7
5. Adult onset diabetes for 30 years	1	2	3	4	5	6	7
6. Patient has viral pneumonia	1	2	3	4	5	6	7
7. Patient eyeglasses on overbed table	1	2	3	4	5	6	7
8. Patient calls male nurse "Elsie"	1	2	3	4	5	6	7
9. Sleeps 7 hours/night	1	2	3	4	5	6	7
10. Usual residence: retirement centre	1	2	3	4	5	6	7
11. Patient 70 years old	1	2	3	4	5	6	7
12. Lights on above patient bed	1	2	3	4	5	6	7
13. T.V. playing in patient room	1	2	3	4	5	6	7
14. Nearsighted without glasses	1	2	3	4	5	6	7
15. Diminished breath sounds lower lobes	1	2	3	4	5	6	7
16. Bowel sounds head in all 4 quadrants	1	2	3	4	5	6	7
17. Oriented to person only	1	2	3	4	5	6	7
18. Medication tray placed on overbed table	1	2	3	4	5	6	7

CUE	NOT VERY IMPORTANT						VERY IMPORTANT
19. Night time	1	2	3	4	5	6	7
20. Patient room painted white/orange	1	2	3	4	5	6	7
21. Blood glucose: 12.2 S.I. units	1	2	3	4	5	6	7
22. I.V. with added medication	1	2	3	4	5	6	7
23. Blood pH: 7.35	1	2	3	4	5	6	7
24. Patient does not respond to nurse's attempt to orient	1	2	3	4	5	6	7
25. B.P. 120/78	1	2	3	4	5	6	7
26. Spiked a slight fever	1	2	3	4	5	6	7
27. Hospitalized 3 days	1	2	3	4	5	6	7
28. Hernia repair 20 years ago	1	2	3	4	5	6	7
29. Drinks 1 cup coffee/day	1	2	3	4	5	6	7
30. On Cimetidine 300 mg. I.V. q. 8h.	1	2	3	4	5	6	7
31. Temperature 37.1°C.	1	2	3	4	5	6	7
32. Clinitest: negative/negative	1	2	3	4	5	6	7
33. Patient hearing aids on overbed table.	1	2	3	4	5	6	7
34. Hgb. 15 gms/100ml.	1	2	3	4	5	6	7
35. W.B.C. 5000	1	2	3	4	5	6	7
36. Serum potassium: 3.8	1	2	3	4	5	6	7
37. On insulin 15 units q. a.m.	1	2	3	4	5	6	7
38. Retired farmer	1	2	3	4	5	6	7
39. Complains of diffuse, intermittent abdominal pain	1	2	3	4	5	6	7
40. Typical hospital day spent watching T.V. in bed	1	2	3	4	5	6	7

APPENDIX K

Mean Rating[a] of Selected Cues[b]
in Simulated Materials for Diagnosis:
Sensory Deprivation related to Diminished Sight and Hearing

Relevance of Cues		Importance of Cues	
Cue Number	$\bar{X}$[c] Rating	Cue Number	$\bar{X}$[c] Rating
*2. patient talking aloud to himself (V)	5.3	*2. patient talking aloud to himself (V)	5.6
*7. patient eyeglasses on overbed table (V)	6.0	*7. patient eyeglasses on overbed table (V)	5.6
*8. patient calls male "Elsie" (V)	5.3	14. nearsighted without glasses (F)	5.6
10. usual residence: retirement centre (F)	5.6	*24. patient does not respond to nurse's attempt to orient (V)	5.3
14. nearsighted without glasses (F)	6.3	*33. patient hearing aids on overbed table (V)	6.3
*19. night time (V)	6.0		
20. patient room painted white/orange (V)	5.6		
*24. patient does not respond to nurse's attempt to orient (V)	5.6		
*27. hospitalized 3 days ago (R)	5.3		
*33. patient hearing aids on overbed table (V)	6.0		

[a]N=3 raters

[b]Only cues which were rated > 5.0 are identified.

[c]1.0=not very relevant/important
7.0=very relevant/important

*Cues considered relevant, according to Tanner and associates (1982), in the development of the videotape (V) and the nursing report (R). (F) designates a cue found in the follow up information.

Mean Rating[a] of Selected Cues[b]
in Simulated Materials for Diagnosis:
Confusion related to New Environment and Time of Day

Relevance of Cues		Importance of Cues	
Cue Number	$\bar{X}$[c] Rating	Cue Number	$\bar{X}$[c] Rating
2. patient talking aloud to himself (V)	6.3	2. patient talking aloud to himself (V)	6.3
3. dimly lit hallway (V)	5.6	8. patient calls male nurse "Elsie" (V)	6.0
7. patient eyeglasses on overbed table (V)	5.6	10. usual residence: retirement centre (F)	6.3
8. patient calls male "Elsie" (V)	6.0	17. oriented to person only (F)	6.6
10. usual residence: retirement centre (F)	6.0	19. night time (V)	6.3
14. nearsighted without glasses (F)	6.3	24. patient does not respond to nurse's attempt to orient (V)	6.3
17. oriented to person only (F)	6.3	27. hospitalized 3 days ago (R)	6.0
19. night time (V)	6.7		
24. patient does not respond to nurse's attempt to orient (V)	6.3		
27. hospitalized 3 days ago (R)	6.3		
33. patient hearing aids on overbed table (V)	5.3		
40. typical hospital day spent watching T.V. in bed (F)	6.0		

[a]N=3 raters

[b]Only cues which were rated > 5.0 are identified.

[c]1.0=not very relevant/important
7.0=very relevant/important

*Cues considered relevant, according to Tanner and associates (1982), in the development of the videotape (V) and the nursing report (R). (F) designates a cue found in the follow up information.

Mean Rating[a] of Selected Cues[b]
in Simulated Materials for Diagnosis:
Confusion related to Side Effects cimetidine

Relevance of Cues		Importance of Cues	
Cue Number	$\bar{X}$[c] Rating	Cue Number	$\bar{X}$[c] Rating
*2. patient talking aloud to himself (V)	5.6	*2. patient talking aloud to himself (V)	5.6
17. oriented to person only (F)	6.3	17. oriented to person only (F)	5.6
*22. I.V. with added medication (V)	7.0	*22. I.V. with added medi-medication (V)	6.0
*24. patient does not respond to nurse's attempt to orient (V)	6.3	*24. patient does not respond to nurse's attempt to orient (V)	6.0
30. on cimetidine 300 mg. I.V. q 8 h (F)	7.0	30. on cimetidine 300 mg. I.V. q 8 h (F)	7.0
39. c/o diffuse, intermittent abdominal pain (F)	6.6	39. c/o diffuse, intermittent abdominal pain (F)	6.0

[a]N=3 raters

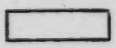
[b]Only cues which were rated > 5.0 are identified.

[c]1.0=not very relevant/important
7.0=very relevant/important

*Cues considered relevant, according to Tanner and associates (1982), in the development of the videotape (V) and the nursing report (R). (F) designates a cue found in the follow up information.

APPENDIX L

Coding Procedure

Code	Description of Code
?	- indicates the subject asked a question
( )	- indicates a cue from the videotape, report, follow-up information. To be coded ( )^{V} if from videotape; ( )^{r} if from report; ( )^{F} if from follow-up information.
	- indicates the data collector led the subject
	- indicates an inference; something that goes beyond the data given
	- indicates the subject is stumped
	- indicates the subject is thinking aloud; also includes questions of the "I'm wondering" type.
	- indicates the subject has summarized the identified problems (or has been asked to summarize the identified problems).
*	- in pencil, indicates the rater has difficulty
*	- in red, indicates the rating team has difficulty reconciling differences.

APPENDIX M

Sample Script with Coding[1]

Sample Script

S: I was asking about the alcoholism because if he was still drinking and he's diabetic, all those things combined, you know, that was something we would want to stop, intervene there (laughs). But if he really hasn't been drinking, he's done all he can as far as that goes to prevent complications. ...At what age did he um was he diagnosed as having diabetes?

T: Okay. And what's your thought there?

S: I'm just not sure when, if adult onset, I figured it was um after 20, or something like that. I just uh wondered how long he's had it, because if he wasn't born with it, then it's something that he -- you know his diet may have had something to do with it. I was just curious (laughs).

T: Okay. He was diagnosed with diabetes mellitus at age 42. He was controlled by diet for 3 years. And then started on Diabinase at the age of 45.

S: Diabinase?

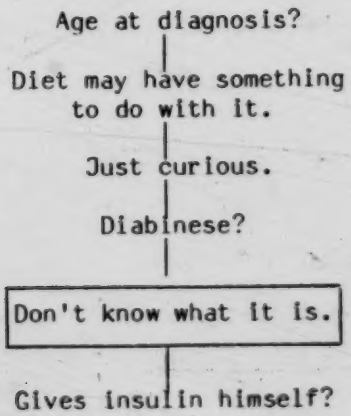
T: Mm-hm.

S: Okay. I don't know what that is, so that's something. I kinda wonder (laughing).

T: At the age of 60 he was admitted to the hospital for diabetes out of control, and has been regulated since then on NPH insulin 15 units every morning.

S: Does he give that to himself?

Coding



[1]Used with permission of Dr. C. Tanner, April, 1984.

APPENDIX N

APPENDIX N
INFERENCES ACTIVATED BY ALL SUBJECTS BY CATEGORY

Kinds of Inferences

Subject	Accurate N (%)	Plausible N (%)	Related N (%)	Implaus. N (%)	Nursing Action N (%)	Other N (%)	AVERAGE N (%)
01 Pre	0		0	0	0	0	0 (0)
Pst	1 (12.5)	7 (87.5)	0	0	0	0	8 (57.1)
Sum	1 (16.7)	2 (33.3)	2 (33.3)	0	0	1 (16.7)	6 (42.9)
02 Pre	0	0	10 (77)	0	0	3 (23)	13 (41.9)
Pst	1 (7)	2 (14)	1 (7)	5 (36)	0	5 (36)	14 (45.2)
Sum	0	0	2 (50)	1 (25)	0	1 (25)	4 (12.9)
03 Pre	0	0	3 (100)	0	0	0	3 (23.1)
Pst	1 (23.5)	3 (37.5)	3 (37.5)	0	0	1 (12.5)	8 (61.5)
Sum	0	2 (100)	0	0	0	0	2 (15.4)
04 Pre	0	0	3 (75)	0	0	1 (25)	4 (15.4)
Pst	0	7 (41.2)	4 (23.5)	3 (17.6)	2(11.8)	1 (5.9)	17 (65.4)
Sum	0	1 (20)	0	1 (20)	2 (40)	1 (20)	5 (19.2)
05 Pre	0	0	4 (50)	0	0	4 (50)	8 (53.4)
Pst	1 (20)	2 (40)	1 (20)	0	0	1 (20)	5 (33.3)
Sum	1 (50)	1 (50)	0	0	0	0	2 (13.3)
06 Pre	0	0	4 (80)	0	0	1 (20)	5 (20)
Pst	1 (7.1)	4 (28.6)	4 (28.6)	1 (7.1)	0	4 (28.6)	14 (56)
Sum	0	2 (33.3)	3 (50)	0	0	1 (16.7)	6 (24)
07 Pre	0	0	2 (66.7)	0	0	1 (33.3)	3 (10)
Pst	1 (4.8)	9 (42.9)	4 (19.0)	0	2 (9.5)	5 (23.8)	21 (70)
Sum	0	1 (16.7)	1 (16.7)	0	3 (50)	1 (16.6)	6 (20)
08 Pre	0	0	16 (84.2	0	0	3 (15.8)	19 (59.4)
Pst	1 (11.1)	6 (66.7)	2 (22.2)	0	0	0	9 (28.1)
Sum	1 (25)	1 (25)	2 (50)	0	0	0	4 (12.5)
09 Pre	0	0	0	0	0	0	0 (0)
Pst	2 (6.7)	8 (26.7	8 (26.7)	1 (3.3)	2 (6.7)	9 (29.9)	30 (90.9)
Sum	1 (33.3)	2 (66.7)	0	0	0	0	3 (9.1)
10 Pre	0	0	10 (83.4)	1 (8.3)	1 (8.3)	0	12 (46.1)
Pst	2 (25)	3 (37.5)	0	2 (25)	0	1 (12.5)	8 (30.8)
Sum	1 (16.7)	1 (16.7)	2 (33.3)	2 (33.3)	0	0	6 (23.1)

Implaus: Implausible
Pre: Number of inferences activated before seeing the videotape
Pst: Number of inferences activated after seeing the videotape, but not including the summary
Sum: Number of inferences activated in the diagnostic summary